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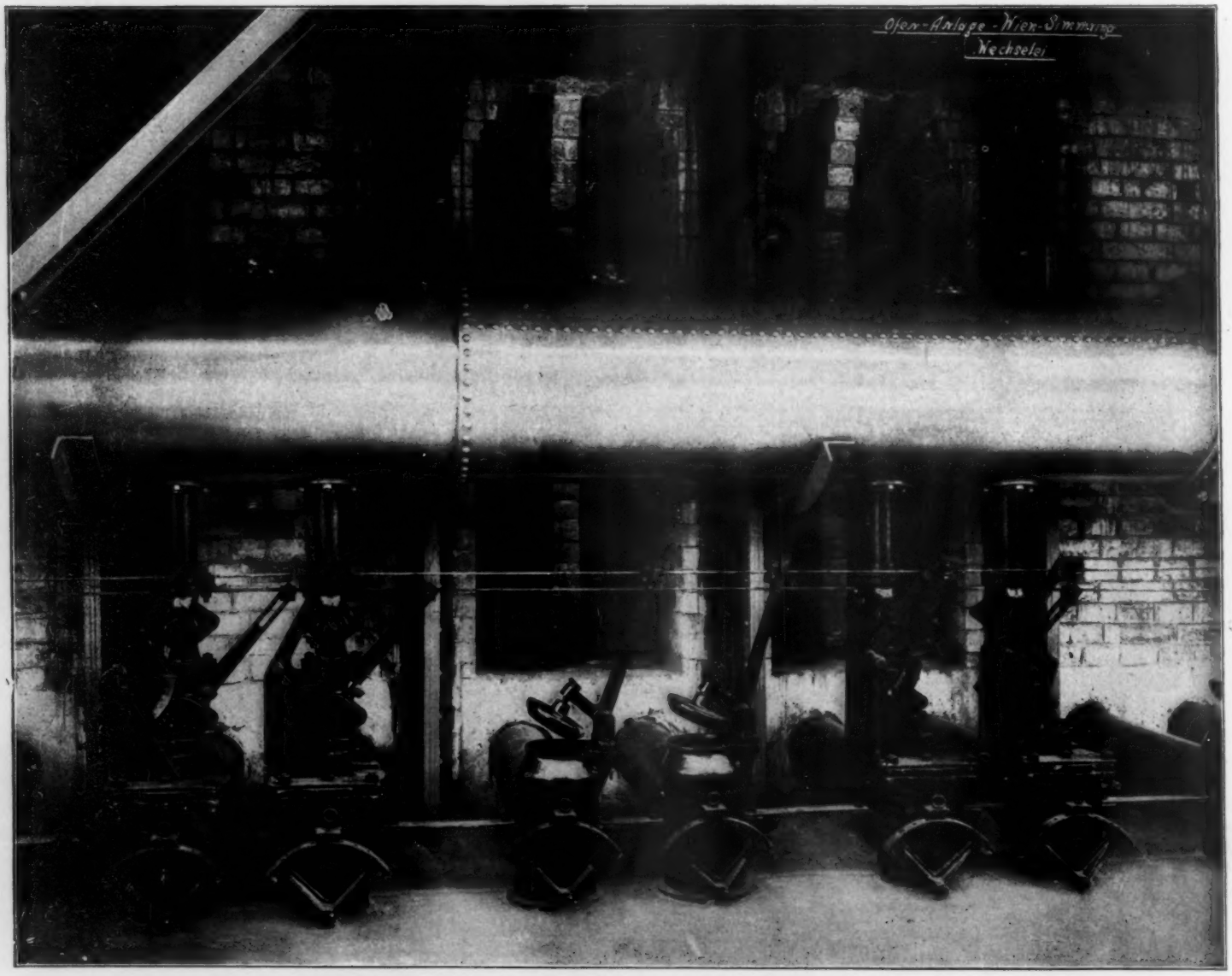

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The Color of Artificial Illuminants.[1]

[Synopsis of a Lecture (Third) Delivered by MR. J. S. DOW at the Polytechnic, Regent street, London, Friday, Feb. 7th, 1913.]

Of the vast range of ethereal vibrations known to physical science, only a single octave (from the deep red, 0.8 μ to the violet, 0.4 μ) is visible to the human eye. Yet, on either side of this visible spectrum, there are other rays, differing from the luminous variety only in frequency, and all having their characteristic properties. For example, the rays of *shorter* wave length than 0.4 μ (the ultra-violet), while invisible to the eye, can produce pronounced chemical effects, which will be referred to later. On the other side we have the long wave vibrations, known as the "infra-red," and mainly characterised by their heating effect; and, with a frequency far less than that of visible light, the electro magnetic waves used in wireless telegraphy.

The great majority of artificial illuminants owe their light to incandescence. They are heated up until, amid the series of non-visible vibrations produced, some visible light makes its appearance. The color of the light depends to a great extent on the temperature of incandesence becoming whiter as the temperature is increased. The quality of radiation corresponding with each temperature has been determined with great exactitude for the "black body." One thing is certain, that the percentage of visible energy is almost always exceedingly low, in some cases less than 1 per cent. The luminous efficiency of the carbon filament lamp has been given as approximately 2 per cent., and that of the metallic filament lamp 5 per cent., while even the flame arc lamp probably only produces about 15 per cent. of its energy in a useful, luminous form.

It has been said that, by increasing the temperature, the yield of light is increased correspondingly. Dr. Drysdale has calculated that, at the enormous temperature of the sun, as much as ½ the total energy produced would be luminous; but we are not within approachable distance of such a temperature as this. Could we only produce visible spectrum, with all the rays present in the same proportions as in daylight, without the useless non-luminous rays, we should presumably obtain an ideal illuminant. Under these conditions it is calculated an efficiency of 25-candle power per watt would be attainable. Now the most efficient illuminant in existence at the present time probably does not give more than 5 to 6-candle power per watt.

It will be observed that incandescent solid illuminants (whether flames, mantles or filaments) give rise to a continuous spectrum, which is one advantage of this kind of radiation. Again, in order to obtain good color-definition, a continuous spectrum is essential, for if certain parts of the spectrum are missing colored objects will obviously not appear in their natural hue. Take an extreme example, the mercury vapor lamp. The entire absence of red in the spectrum of this illuminant makes red objects appear lead black.

The mercury arc of course would not be used for work where accurate color matching is attempted; but even other illuminants, the electric glow lamp and the mantle, are not identical with daylight. It is true that none of the colors in the daylight spectrum are actually *missing*, but they are not present in sufficient intensity. Taken as a whole, almost all artificial illuminants contain relatively more red and less blue in their composition than daylight. There are, however, some which approach nearer to daylight than others; acetylene is claimed to do so (although it must be admitted that such data as are available suggest that this illuminant, too, is distinctly weak in the blue violet). The inverted arc light has been claimed to approach daylight very closely, and in England it has been quite widely used for color matching; but, perhaps, the most familiar example of an illuminant expressly designed to imitate daylight is the Moore carbon-dioxide tube. This illuminant appears to have been widely used in the United States, and there are now some Moore white light installations in England (mainly textile works in the Midlands). Quite recently one such installation has been put up in London.

A very interesting novelty of recent years is the daylight screen, prepared by Dr. Kenneth Mees, in England, for the use with the tungsten lamp. By subtracting certain rays in the requisite proportions this is said to convert the light from the tungsten lamp into the exact equivalent of average daylight. (Similar screens have been devised in the United States by Ives and Luckiesch.) An advantage of this method is that it can readily be applied to an existing electric installation without trouble. One merely prepares a small cabinet illuminated by one of these units and separated from the rest of the premises which are illuminated in the ordinary way. It is true that the loss of light is very considerable (probably as much as 80 per cent.), but in many cases this is of little moment in comparison with the advantage of being able to carry on color work by artificial light.

Another advantage of this "subtractive" method of producing "artificial daylight" is there seems no reason why it should not be applied to other illuminants. Experiments, it is understood, are

1. For the prior lectures (1 and 2) see Feb. 17, p. 109; and Feb. 24, p. 130, respectively.

actually being carried out in England on incandescent mantles with a view to producing a daylight unit for gas. Although it is very questionable whether people in general would desire artificial daylight for ordinary purposes, they nevertheless seem to prefer the mellow tint of existing illuminants. But for certain special branches of work its advantages are incontestable. For example, in dyeing works, carpet manufactories, textile works, color printing, etc. There are certain industries in which no one would at first sight suppose accurate color discrimination important, but where, nevertheless, it comes in. For example, the grading of hops and tobacco, and even malt and beer, is carried on to a great extent by the appreciation of minute changes in the color of the material, and in quite a number of cases, some form of "artificial daylight" has been installed. As an instance, the first Moore white light installation in London is in a city firm interested in hops.

The great advantage of artificial daylight is that it permits work to be carried on independently of climatic variations. It may be that the quality of the light is not absolutely identical with daylight, but it is far more constant, both in quality and quantity. Daylight varies enormously from day-to-day. It is well known that the color of the light received from a white cloudy sky and from direct sunlight are not the same. Moreover, it may easily happen that a series of dull foggy days actually makes accurate color work impossible. This will not happen when artificial daylight is available, and, of course, under the conditions the hours of work can be prolonged into the night.

There are at present quite a number of illuminants claiming to resemble daylight, and one would like to see more thoroughly and complete tests of all these carried out. There are also other illuminants, such as high pressure gas and petrol-air gas, the color of which gas does not seem to have ever been analysed very closely. In testing color quite many varieties of methods are available, one of the best, from a scientific standpoint, being the spectro-photometer. Uuseful data can also be obtained by the methods employed by Mr. Ritchie, described in a paper before the Illuminating Engineering Society, London, during 1911. For example, observation of the reflecting power of a series of colored ribbons by daylight and artificial light, photographic methods, and color-tests with the tinto meter, etc. At first sight it might be supposed that color photography would be one of the best methods of demonstrating the changes in color caused by various illuminants. Mr. Macinney and the lecturer once prepared a lumiere plate, showing the appearance of two identi cal bunches of flowers set up side by side and illuminated respectively by a tungsten and a mercury vapor lamp. As a popular method of demonstrating change in color such slides are useful; but the difficulties in the way of scientific accuracy seem considerable.

Let us now turn to another aspect of the color of illuminants. In what has been said above it has been shown that there are many cases in which a genuine white light—*i. e.*, a close resemblance to artificial average daylight—is extremely valuable; but there are also circumstances in which the color of an illuminant is not important and *brightness* is the main consideration. For example, in illuminating a railway yard, a beacon or an advertisement sign. It is, therefore, worth noting that, for such purposes illuminants making liberal use of the principle of luminescence (*i. e.*, using luminescent gases which give line-spectra) are often advantages. It has been shown that the eye is most sensitive to the central yellow-green region of the spectrum, therefore it is clearly economical to produce this kind of light rather than the extreme red and violet which the eye can only perceive with difficulty. The high efficiency of some modern illuminants, notably the yellow flame arc lamp, is due to the fact that substances are used giving several very vivid lines in the yellow.

In one sense a source of light which produced visible white light, and no invisible vibrations, might be said to have 100 per cent. efficiency. Yet it obviously would not give as bright a light as one which contained only the highly efficient yellow-green rays. Could we but confine the radiation from an illuminant to this region of the spectrum it is probable that as much as 60-candle power per watt might be obtained.

Cases are often met where light of a certain color is specially useful. For example, it is well known to students of physiological optics that for moderate distances (say beyond 10 feet or so) the eye finds it increasingly difficult to focus blue and violet light, whereas it can focus red rays with ease. Consequently a sheet of test type illuminated red light will appear very distinct to the eye, but the letters will appear blurred when pure blue light is used. This is due to the fact that the eye is not achromatic. For the illumination of signs to be seen at a distance, therefore, red light is preferable to blue—in fact, it would often pay to use a yellow or orange screen and so cut off the blue end of the spectrum; such rays are or may be actually prejudical, as they cannot be focussed and spread out forming a luminous haze and impairing the sharpness of the image. For distant work, therefore, the red end of the spectrum is best; but for very near work it might be found that blue rays were preferable, which possibly explains why the blue end of the spectrum is admittedly best for microscope work.

Another quality of light closely connected with wave length is penetrating power. There seems good reason to suppose that light from the red end of the spectrum is best in a fog, which is merely an illustration of the general physical law that rays of long wave length can pass obstacles most readily. An extreme instance of this is provided by the waves used in wireless telegraphy which are merely ethereal vibrations of very great wave length. It is conceiveable, therefore, that in designing an illuminant for use in circumstances where fog, smoke or mist are prevalent one should give preference to the red end of the spectrum.

The suggestion that one should deliberately aim at producing certain qualities of light, as well as studying intensity, may seem rather far-fetched, because our power of altering the character of the light from illuminants is at present so limited. Almost the only practicable way of producing blue light, for example, is to use a blue glass screen with a white light thus absorbing and wasting by far the greater part of the light generated. At present we have no ready means of producing monochromatic light in large quantities. It is as though, when one wishes to play the piano, one could not strike one note without being obliged to sound all the others as well. When we have learned better how to control the spectrum of illuminants, and how to produce light of any desired wave length at will, new and unsuspected use for colored light will doubtless be made known.

Two notable illustrations of this may be mentioned. First, we may take the well known Finsen light. In this lamp a strong blue light is produced by merely using a blue screen in front of a very powerful arc. The method is, of course, very inefficient, but it serves to produce blue light in the desired volume. The curative power of this light in many skin diseases (lupus for example) seems well established; but it was only by having at one's command means of generating abundant blue light that this valuable quality came to be tested and recognized.

The second instance which occurs to one is the ultra-violet radiation, now obtainable in large quantities from such illuminants as the quartz-tube, mercury vapor lamp. These rays appear to be at present finding quite a number of useful applications; *e. g.*, for tanning leather, treating skin diseases, sterilizing infected water, etc. But perhaps their most interesting use is in testing the permanency of colors. The fading away of colored materials has long been attributed to the chemical action of the ultra-violet element in sunlight. The merchants in the north of Germany used formerly to send their wares to the sunny south where they could be subjected to prolonged sun testing; but by the aid of the modern artificial sources of ultra-violet light it is possible to test the permanency of such colors independently of the external climatic conditions, and to do in a few days what formerly required months to accomplish.

It need not be said that some care is usually needed in experimenting with comparatively new forms of radiation. The experiences of early workers with the x-rays furnish a case in point. In the same way it is known that excess of ultra-violet energy may be prejudicial to the eyes and it is, therefore, necessary to take special care to avoid injury when these rays are present. For example, special glasses should be worn by those working with a naked arc light or quartz-tube mercury lamp, and by operators using the electric arc or oxy acetylene flame for welding operations.

As a final example of the action of the ultra-violet rays reference may be made to their use in exciting phosphorescence. We seem still far from the ideal phosphorescent "cold light;" but seeing that this effect is excited largely by the agency of the ultra-violet rays it is possible that the discovery of sources still richer in this kind of energy, and of substances more sensitive to its action, may lead to important developments in the future.

Mr. V. R. Molinard, General Manager of the Oklahoma Gas and Electric Company, has been appointed to the Faculty Board, University of Oklahoma, located in Norman, Okla. He will, in due course, deliver a series of lectures in "Electrical Engineering," before the Senior Class of the University.

Measurement of Lights of Different Colors.

[Communicated by Dr. Leonard Keene Hirshberg, A. B., M. A., M. D., Johns Hopkins, Baltimore, Md.]

Prof. Herbert E. Ives, in two learned technical articles which have appeared in the "Philosophical Magazine," gives the result of an investigation into the photometric effects of lights of different colors. His results are interesting enough to present in a popular account. The advent of incandescent lamps of great efficiency and other new lights with a wide range of color, the prospect of an even larger variety in the near future, which will diverge in tint still further from present illuminants, all render the problem of measuring the luminosity of various hues, one of great importance. The mere comparison of two differently colored lights is no more possible than is the exact comparison of sound with odor. Some methods of course have been discovered which, in the process of measurement either evade or eliminate the differences in hue; but as different methods require different standards, so Dr. Ives proposes to obtain a relation between the various criteria.

The chief obstacle, he says, in the way of giving preference to one method over another, is a woeful want of statistics or data, which defects Dr. Herbert Ives hopes and proposes to remedy. Of the plans for illuminating measurement which have been applied to differently colored lights, one is the method of equality of brightness. Two colored lights illuminate two portions of a background or photometric (measure of light) screen. The relative intensities of illumination from the two lights are changed until the two differently colored fields give a sensation of equal brightness. The illuminations are then said to be equal.

The method of acuity of sight is merely the way of proving two colors equal when the same fineness of detail is just distinguishable by each, while the method of critical frequency holds that two illuminations are equal when the flicker produced by rapid alternation of one illumination with black disappears at the same speed of alternation as the other.

Two illuminants are also said to be equal when, upon rapidly alternating one with the other, no sensation of flicker results. The speed of alternation is such that the slightest change of either will cause a flicker.

Dr. Ives discovered that the best standard must center around the flicker and the equality of brightness of the colors. So he then determined by the two methods the degrees of luminosity of the various tints and colors of the spectrum. The original findings of his numerous experiments are most helpful.

He found that the flicker method is much more sensitive than the equality of brightness method, particularly where colored lights are concerned, and that the results with the flicker method are more easily reproduced than with the equality of brightness plan. While decrease of illumination shifts the maximum of luminosity toward the blue in the equality of brightness method, yet with the flicker method it shifts towards the red.

Decrease in the size of the measured field of light in low illuminations, shifts the maximum of luminosity toward the red for the equality of brightness (called the yellow spot effect) and toward the blue with the flicker method. The results are also most different at low degrees of illuminations upon large fields. They are nearest together at high illuminations and a small surface or field of light. With the hope of shedding some light on the peculiarities of the flicker method other experiments were carried out. Dr. Ives' results have served to clear up the seeming discrepancies of various observers, and these were brought into record by proving that a change in experimental conditions yields change in the results.

He also shows that the retina is found to be more sensitive to flicker farthest away from its central point, only on momentary observation before fatigue or adaptation sets in. The point of best vision (the fovea) is more sensitive to red flicker, while the periphery, or outside part of the retina, is more sensitive to blue lights, and that these differences are greatest at low degrees of illumination.

Mr. Halver L. Halvorson, President of Minot, No. Dak., declares that, if the citizens of Minot elect to establisn a municipal lighting plant of the electrical type, he believes that the scheme should also include a gas plant. Despite his name the President of Minot evidently does not believe in doing things by halves!

Report of Committee on Consumers' Meters.

[Presented at the Seventh Annual Meeting, American Gas Institute, by Mr. Charles C. Schiller, Chairman.]

Since the appointment of this Committee there have been held a number of meetings at which the general subject of meters was fully discussed. This discussion did not develop that there was any one phase of our subject, other than meter testing, the further study of which, at this time, might prove particularly beneficial to either the meter maker, the gas company or to the gas consumer. The subject of meter testing, however, seemed to offer opportunities for investigation, and in consequence, considerable research work has been done along these lines during the past 2 years.

It seemed desirable that an investigation of the matter of testing meters be made, because the general experience had been that upon successive provings of meters removed from service, using air as the proving medium, a constant proof could not always be obtained, the tendency being for the readings to become progressively higher. In some localities meters, upon removal from service, are subjected to a gas company's test, a city inspector's test, and to a State inspector's test, and the test thus obtained in each case is accepted as the official proof of the meter, notwithstanding the meter becomes increasingly higher on each test.

In view of this fact, need of determining the proper means for obtaining correct and constant meter tests appeared an urgent and serious matter, the solution of which should be of importance to every gas company. Your Committee, therefore, desires to submit the following report and recommendations, based on data already obtained, pertaining to changes in volume of the medium employed for proving meters, and in the practical testing of meters upon their removal from service, when using air, when using illuminating gas, and when using illuminating gas saturated, at temperature of the proving rooms, with suitable vapors.

It has heretofore been the general practice, in testing gas meters, to utilize air as a medium for determining the relative accuracy of consumers' gas meters. The general opinion has been that temperature was the only variable factor in meter testing, of sufficient importance to require attention, and that since all gases, in so far as change in volume was concerned, were affected alike by changes in temperature, the use of gas or air for this purpose was optional. The liability of variations in volume, because of changes in vapor tension within the meter proving instrument during the operation of testing or proving meters, was understood; but it had been reasoned that, under normal conditions, and with the meter, the proving instrument and the air in and about the prover all at one temperature, this was of negligible consequence and, therefore, it made little practical difference whether gas or air were used. For this reason, and because of its supposed greater freedom from possible accident, the ease with which its temperature could be controlled, and the further advantages as to cost, cleanliness and convenience, the use of air became the established practice.

Within all meters there collects, more or less, an oily liquid ordinarily spoken of as "condensation." This liquid is deposited by the gas during its passage through the meter, and as a result of changes in temperature conditions, affinity of the oils with which the diaphragms are saturated, and affinity of the oil contained in the bottom of the diaphragm compartments, for the hydrocarbon vapors carried by the gas. Advances made in the methods of gas manufacture have brought about marked changes in the nature of the condensation found in meters, a lighter and more volatile condensate, harmful to valve action and to the diaphragms, is now deposited in those meters, passing a mixed gas or a straight carbureted water gas. The volatile character of this condensate has brought about a condition within the meter which is a disturbing factor, and responsible for changes of consequence in the volume of the testing medium during its passage through the motor at time of testing. Certain experiments have shown that changes, equal to an increase of 2 per cent. in volume, occur in some of the meters, as ordinarily tested.

The customary method of testing or adjusting a meter is to compare the reading of the index of the meter with the calibration of a standard meter prover, after there has passed through the latter, a quantity of air or other gaseous matter sufficient to cause the proving head pointer of the meter index to make one complete revolution. The quantity actually passed from the prover through the meter is read on the scale of the prover, and the relative accuracy of the meter under observation thus determined. The manual operation of test-

ing meters is itself quite simple, but accurate meter testing is dependent not alone upon the accuracy of calibration of the proving instrument in the first instance, but requires that the volume of the proving medium used in measuring remain unchanged during its transfer from the prover and passage through the meter. Because the two operations of testing and of proving meters, are, or should be done, in workshops equipped with modern systems of heating and ventilating, and specially arranged for this purpose, the requirement of uniform temperature conditions can be satisfactorily maintained within reasonable limits. While uniformity of temperature is absolutely essential, the actual temperature to be maintained can be more or less arbitrarily chosen. Uniformity of temperature of the meter under test, of the testing medium, and of the proving apparatus is deemed imperative. To assume uniformity of temperature during the operation of testing meters being had at all times, attention should be given to the following physical laws:

1. Heat tends to pass from a body at a higher temperature to one of lower temperature, thus changing the temperature of both.

2. Heat may be transferred by radiation, convection, or conduction.

Radiated heat passes through air or other gases without materially affecting the temperature of same, but is absorbed to a maximum extent by dull and black bodies, the temperatures of which are in consequence raised. Heat is reflected to the greatest extent by polished white surfaces. Bodies also give off heat in more or less direct proportion to their power of absorbing heat. The diffusion of heat through a liquid or gas by motion, or circulation of its constituent particles, is termed convection. For instance, gases and liquids upon being heated rise (the rising particles being replaced by descending currents of colder particles) and thus transfer heat. Conducted heat is that understood to be propagated by the transference of heat from one particle of matter to another, without any visible motion of matter. As a rule metals and other solids conduct heat better than liquids, and liquids better than gases, thus:

Relative Heat Conductivity.

Copper	18,000
Water	25
Air	1

The equipping and operating of a room devoted to testing meters should be done with a view of minimizing errors due to radiation, convection and conduction of heat. The two latter modes of transference of heat may be minimized by providing a well-insulated proving room with suitable means of regulating temperature, avoiding the possibility of sudden temperature changes and draughts incidental to some forms of ventilation. Radiant heat sources should be excluded. This includes direct sunlight, as radiant heat can thus be transferred to proving apparatus through glass partition or windows. In this connection it is pointed out that a polished metal meter prover bell minimizes absorption of radiant heat by reflecting from its surface such heat waves.

3. The evaporation of liquids is attended by an absorption of heat from surrounding bodies, whereas the condensing of a vapor is accompanied by an evolution of heat and a transference of same to surrounding bodies.

The surface of a meter-prover bell should be polished, so as to shed water, and thus prevent the formation of a film of water on the surface of the bell at the time it is raised. A film of water on the bell, upon exposure to air or to gas, which is not saturated with water vapor, tends at once to evaporate, absorbing heat from the surrounding matter, in this case cooling the atmosphere, the meter-prover bell and the contained proving medium. The evaporation from the inside surface of the proving bell, aside from changes in temperature, adds to the volume already contained, through the addition of water vapor. Experiment has shown that an actual contraction of the contained volume first takes place, during which time the prover can be seen to fall. This action may extend over a period of from 6 to 8 minutes, at the expiration of which time the contained volume will begin to expand and the prover bell will rise above the original height, due to transference of heat from the surrounding air to the medium contained within the prover, and the increased vapor tension due to the water evaporated from the inside surface of the proving bell. The importance of this factor is relative, depending somewhat on the size of the prover, degree of saturation, and movement of surrounding air, as well as the speed at which the prover is operated.

4. The temperature of gas may be changed by compression or expansion.

It is becoming more and more the practice to supply air or gas used for testing from a source which is at a pressure higher than that for which prover is weighted, so as to avoid thereby the necessity of raising the prover bells by hand. Such pressures, if much higher than prover pressure, should be reduced to approximate prover pressure, prior to its passage into the prover, by means of a governor. Between this governor and the cock at the prover, there should be a length of piping sufficiently long to insure that the air or gas introduced into the prover is at a temperature agreeing with the temperature of the proving room. The use of piping exposed for some length to the temperature prevailing in the proving room is an easy and practical means of insuring uniform temperatures, and is applicable to those cases where the temperature of the gas varies because of seasonable changes, and especially where gas is taken direct from company services. The high conductivity of the piping, together with the low specific heat of gases, affords an easy control of temperature in this manner, especially when the quantity factor is not large.

The four considerations discussed thus far concern the need of uniformity of temperature, both of the meter to be tested and of the meter prover used as a standard, as well as the surrounding air, and the testing medium within the meter prover. There frequently are compensating conditions which serve to equalize temperatures, or to minimize the theoretical effect to be expected. Then, again, conditions tending to produce minus errors may be offset by effects tending to produce more or less equal plus errors in the meter proofs obtained. It can be accepted that the results usually attained when due care is exercised approximate a fair average of accuracy; but, on the other hand, there can be no question as to the wisdom of taking into account all factors involved, as the degree of accuracy obtained, not only in the test of a meter but of all meters tested, will be dependent upon the provisions made for eliminating all possible sources of error.

As pointed out in the beginning of this report, there are two considerations principally involved in obtaining the correct proof of meters; namely, uniform temperature and constant vapor tensions. By constant vapor tension we mean, in so far as the testing of meters is concerned, *constancy of proving medium* throughout the operation. This medium may be air, illuminating gas, or prepared gaseous mixtures; but, in any case, the following exposition of the physical laws involved should be considered when a fair degree of accuracy is sought:

1. When a given liquid is in contact with a given gas, there will be an interchange of each into the other until, at any given temperature and pressure, an equilibrium has been established. In other words, the liquid will evaporate until it has saturated the gas with the vapor of the liquid, and at the same time the gas will dissolve in the liquid until the liquid is a saturated solution of the gas.

2. At a given temperature and a pressure, the amount of liquid necessary to saturate a given volume of gas is always the same; likewise the volume a given gas which will dissolve in a given amount of liquid is the same for a given temperature and pressure.

3. An increase in temperature or a decrease in pressure usually increases the amount of vapor that a given volume of gas can hold, while a decrease in temperature or an increase in pressure increases the volume of gas a given amount of liquid will dissolve.

4. An increase in pressure or a decrease in temperature of a given volume of gas saturated with the vapor of a given liquid condenses part of the vapor to liquid.

5. The vapor of any liquid saturating a gas at a given temperature exerts a definite pressure called "vapor tension," which is directly proportional to the volume of the vapor in the gas.

6. The vapors of liquids, not miscible or soluble in one another, exert their individual "vapor tension" when saturating a gas at a given temperature, and hence exist in the same percentage by volume as if each were individually saturating the gas.

7. The vapors of liquids miscible or soluble in each other exert a combined "vapor tension," usually somewhere between their combined individual vapor pressures, and hence do not exist in the same percentage by volume as if each were individually saturating the gas.

Whatever the measuring medium used in meter proving, it would appear that it should be saturated with water vapor at the temperature of the prover, and should remain so throughout a given operation of testing or proving a meter. Attention should be paid to the fact that change in pressure affects the vapor content, hence the volume of the saturated gaseous proving medium and also, that a prov-

ing medium which is not saturated with water vapor tends to saturate itself while in the meter prover, and hence increases its original volume at room temperature.

The standard prover used in testing and proving meters consists of a cylindrical metal bell, travelling between guides, and suspended by means of a counterweight over and projecting into a tank of water. The contents of the bell are expelled by lowering the bell into the water and *vice versa;* the raising and lowering of the bell being controlled by certain cocks. The meter provers usually are very carefully constructed, the bells being carefully balanced, free from binds in their action, and calibrated with a marked degree of accuracy, and permit, when properly handled, of very accurate work in obtaining the proofs of meters. The water seal, however, presents a disturbing factor as to vapor tensions, which factor is heightened by the exposure of the wetted sides of the bell, both inside and out, after each successive operation of raising and filling the bell with the proving medium. As before pointed out, there will be an interchange, dependent upon the degree of saturation of both, between the testing medium and the water in the tank. In ordinary meter proving or testing, very little attention has been given to this matter, because the possible error that could be introduced, traceable to this condition, has been regarded as negligible, except in the calibration of the proving instrument. In the calibrating of the meter provers, which is a much slower operation than testing or proving meters, it has always been recognized as very important that the air should be as near the water saturation point as it was practicable to attain, and considerable care is always exercised to insure the maximum saturation of the air so used. This saturated condition within the prover bell at time of calibration can be secured by allowing the contained medium to remain in contact with the water within the bell long enough to become thoroughly saturated with water vapor; or the contained medium can be sprayed with water by means of a pump, the spraying nozzle of which can be introduced within the prover bell. Because of the wetted sides of prover bell, it is also required that the air of the room be also saturated, and this condition is usually secured by the wetting of the floor and the hanging about the room of a number of wetted sheets or blankets. The importance of saturation has been demonstrated in a practical way, by first testing a number of provers in comparison with a standard cubic foot bottle, using air that had remained long enough within the provers to make saturation likely, and repeating the experiment, using air taken into the prover just prior to making a test, no precaution being taken to obtain saturation. Under the first mentioned conditions of testing, the *provers* showed an average error of 0.17 per cent. slow, and under the second condition an average error of 0.68 per cent. slow. This increase, in the second case, in the contents of the bells of the provers, was undoubtedly due to the expansion of the contained volumes as a direct result of the picking up of the water vapor during the operation of testing. It, therefore, is evident, that the use of air or gas which is not saturated with water vapor, at the temperature at which it is used as a medium for proving meters, may produce errors in the proofs of either new or old meters which may be serious.

Within the meter we find a much more favorable condition for vaporization, and consequent change in the volume of the proving medium, our investigations showing this especially to be the case when air was used. In order to determine, in a practical way, to what extent the accuracy of meter testing was affected by the presence of the highly volatile oils forming the condensate now usually found within the meter, arrangements were made to re-measure the testing medium used in obtaining the proof of each meter of a number of meters included in the investigation. This was done by means of a wet test meter, connected in series to the outlet of each meter tested, so that the testing medium first passed through the dry meter, and then through the wet test meter, the increase in volume being shown by the index of the test meter in comparison with the reading shown by the standard meter prover scale used. The wet meter was adjusted to agree with the prover at the rate under which meters were to be tested, and was frequently checked with the prover. Care was exercised to see that all other conditions were as near correct as practicable. Each dry meter tested was one that had just been removed from service, and had not been uncapped prior to making this special test. Altogether about 200 meters were tested in this manner.

The procedure was to connect each dry meter to the prover in the usual way, and then to connect to the outlet of the dry meter, the wet meter. On the outlet of the wet meter was attached a cock carrying a second cock used as a rate check. This rate check had been fixed to pass 30 cubic feet per hour at which rate the wet meter had also been adjusted. The first cock was used to start and stop the tests, so there would not be any appreciable error due to compression or lag in meters. In this manner the runs were started and stopped with the meters under prover pressure. Two successive 2 foot runs were made with each meter tested. Each experiment was started with both prover and wet meter set at zero, and with the proving head pointer of the meter being tested on the up travel, and exactly over one of the divisions of the dial. Two cubic feet were then allowed to pass from the prover through the meters, after which the wet meter was read. The difference between this reading and the 2 feet shown by the prover was accepted as representing the change in volume that had taken place *within* the dry meter under observation.

A regular prover test of each meter was also taken coincident with the special test made. In the case of the fast meters, the run was interrupted by shutting off the cock on the outlet of the test meter, long enough to take a reading of the prover, after which the special test was completed. In the case of the slow meters, the test was again continued after the reading of the wet meter was taken, so as to obtain a test, from the prover of the dry meter under observation. These tests for accuracy of registration will be referred to later.

With the object of determining the comparative value, not only of gas and air, but also of each of these mediums when saturated prior to their entrance into the meter prover, a saturator was constructed consisting of a container filled with sponges, into which was introduced the saturating liquid. This device was fitted with baffles in order to insure complete saturation, and was connected to the inlet of the prover, so that the air or gas used as the proving medium could be drawn through same prior to its entrance into prover. With the use of this apparatus we were enabled to prove meters using: (1) Air; (2) air saturated with water vapor; (3) air saturated with condensate vapor; (4) gas; (5) gas saturated with water vapor; (6) gas saturated with condensate vapor. The condensate used was some removed from other meters at that time, and was regarded as representative of the liquor found ordinarily in the meters.

The change in volume, it will be noted, is much less in the tests in which gas, saturated with vapors of condensation, was used than in any of the other tests.

Percentage of Increase in Volume of Proving Medium Caused by Passage of Same Through Meters.

	Non-dipping not over 5 Years Old		Dipping not over 1 Year Old.		Non-dipping over 10 Years Old.	
Proving Mediums.	1st Test. Per Cent.	2d Test Per Cent.	1st Test. Per Cent.	2d Test Per Cent.	1st Test. Per Cent.	2d Test. Per Cent.
Air	0.48	0.54	0.85	0.71	1.16	0.88
Gas	0.20	0.21	0.17	0.30	—0.25	—0.24
Saturated air (water)	1.05	0.88	1.25	1.10	1.06	0.78
Saturated gas (water)	0.35	0.31	0.29	0.25	0.41	0.41
Sat. air (condensation)	0.50	0.43	0 53	0.46	0.49	0.48
Sat. gas (condensation)	0.23	0.15	0.03	—0.01	0.15	0.10

A summary of the results obtained shows that the average percentage of increase in volume, when ordinary atmospheric air was used, to have been 0.84 per cent. on the first run, and 0.72 per cent. on the second run. Nearly half of these meters showed an increase of 1 per cent. or more, the average of the "10 year" meters being 1.16 per per cent. One meter showed an increase of 1.87 per cent.

The average increase in volume when ordinary gas was used was but 0.04 per cent. on the first run and 0.09 per cent. on the second run. But with gas it was found that, in the case of one third of the meters, there was a slight decrease in volume. It was noticed that, whereas with ordinary air the increase in volume was greater with the older meters, with gas, the older meters showed, as a rule, a slight decrease in volume.

The use of either air or gas, saturated with meter condensate, gave the best results. Not alone was the average *net* change in volume less, but the changes in the different meters were within smaller confines. With saturated air the average error was but 0.51 per cent. on the first run, and 0.48 per cent. on the second run, while with saturated gas the average error was 0.14 per cent. on the first run, and 0.09 per cent. on the second run. Furthermore, it developed that the second test of meters for accuracy of registration was in closer agreement with the first test where the medium used had been saturated with gas condensate.

The data obtained in the experiments made using only water as a means of saturation was confusing, and would seem to indicate that a very complex question of vapor tensions was involved.

It is a well-established fact that, when air is used in the ordinary

way as the testing medium, successive prover tests of meters removed from service show progressively faster with each test, in the vast majority of cases. This is due, no doubt, to the absorption by the testing medium of the volatile condensate with which the meter diaphragms are more or less saturated upon removal of the meters from service. The effect of this absorption or evaporation is to harden the leather slightly, causing a reduction in the capacity of the diaphragms per revolution of the tangent. This gradual hardening of the diaphragms, in turn causes the meters to become faster on each successive proof test, until such a time when the diaphragms have given off all the volatile liquids with which they were saturated. This effect is produced on both dipping and non-dipping meters, but to a smaller extent on the dipping meters, when either air from the proving room, or gas from the shop piping system, is used as the testing medium, and no attempt has been made to saturate same.

In order to determine the effects of air, of gas, and of saturated gas upon the proofs of meters removed from service, and tested under the usual conditions to be met with in a properly maintained meter shop, an investigation of the subject was conducted on a practical working scale, in a large city where a mixed coal and carbureted water gas was supplied to the consumers. The handling and proving of the meters were done by several men, who were in no way personally interested in the ultimate outcome of the investigation. No attempt was made to obtain other than the usual care exercised under everyday working conditions in proving the meters. The proofs of all meters showing an error of 10 per cent. or less, removed from one section of the city during 3 months, and from another section during a period of 4 months, were included in the compiling of the data, as summarized and herein shown in table form. In order to obtain results along parallel lines, alternate meters, as received from service, were proved with air and with gas, or with saturated gas. Each meter received a second proof test immediately following the first test. This second proof was obtained in order to show the comparative variation between the two proofs when using air, when using gas and when using saturated gas as the proving medium. . . .

as it was possible to attain. Immediately at the conclusion of the test, they were again tested; first, with gas saturated with benzol vapor; then with air in the ordinary manner. Under each of the 3 conditions of proving, each meter was given 2 consecutive tests. The proofs obtained when using gas and when using saturated gas were alike, but when using air the first proof thus obtained was not the same as the proofs obtained with gas, and on successive provings with air the meters became progressively faster.

The fact that the use of saturated gas gave consistent proofs which agreed with the proofs of the meters under actual service conditions, while air gave widely varying proofs which did not agree with the actual proofs of the meters in service, seems to clearly point out the advisability of using as a proving medium gas saturated at proving room temperature, with the water and hydrocarbon vapors which it would be likely to pick up in its passage through the meter prover, and through the meter under test.

The ideal condition under which to prove consumers' meters would be with gas, similar in every respect to the gas which had passed through each meter just previous to its removal from the consumers' premises. It is perfectly obvious, however, that this would be an impossibility, and in lieu of obtaining such ideal conditions, a medium should be employed which would least alter the condition inside of the meters, in its passage through meters undergoing the proof test. Gas, obtained directly from a main, or from a system of house-piping, at the location of the meter proving room, may be of almost any degree of saturation, depending upon the drop in temperature to which it has been subjected after leaving the gas works, and the opportunities presented for it to pick up vapors before being used, at a comparatively high temperature, as the medium for proving meters. Should an unsaturated gas be passed through a meter which had been operating under such temperature conditions, at the time of its removal from the consumer's premises, as would cause a deposition of water and hydrocasbon vapors inside of same, the deposited water and light oils would readily give up to the unsaturated gas the available vapors necessary to satisfy its vapor tension, thus

Average Net Errors of First and Second Proofs of Meters Removed from Service During July and August, 1911.

	Air.				Saturated Gas				Difference Due to Use of Saturated Gas.	
Class.	No. of Meters.	1st Test Per Cent.	2d Test Per Cent.	Difference on 2d Test Per Cent.	No of Meters.	1st Test Per Cent.	2d Test Per Cent.	Difference on 2d Test Per Cent.	1st Test Per Cent.	2d Test Per Cent.
No. 1	280	—0.29	+0.42	0.71 faster	285	—1.79	—1.57	0.22 faster	1.50 slower	1.99 slower
No. 2	191	—1.12	—0.55	—0.57 faster	169	—1.14	—1.19	0.05 slower	0.02 slower	0.64 slower
No. 3	439	—0.78	—0.20	0.58 faster	411	—1.10	—1.17	0.07 slower	0.32 slower	0.97 slower
NOTE.—Gas used for testing purposes was saturated with condensation obtained from non-dripping meters.										
During September, 1911.										
No. 1	58	—0.90	—0.71	0.19 faster	60	—1.82	—1.91	0.04 slower	0.92 slower	1.20 slower
No. 2	128	—0.92	—0.19	0.73 faster	103	—0.73	—0.94	0.21 slower	0.19 slower	0.75 slower
No. 3	295	—1.04	—0.38	0.66 faster	274	—1.39	—1.79	0.40 slower	0.35 slower	1.41 slower
NOTE.—Gas taken direct from house-piping into prover.										
During November and December, 1911, *and January and February*, 1912.										
No. 1	232	+1.08	+1.90	0.82 faster	225	+0 89	+0.52	0.37 slower	0.19 slower	1 38 slower
No. 2	428	—1.23	—0.79	0.44 faster	428	—1.49	—2.27	0.78 slower	0.26 slower	1.48 slower
No. 3	1,267	—0.85	—0.42	0.43 faster	1,221	—1.44	—2.01	0.57 slower	0.59 slower	1.59 slower

NOTE.—Gas used for testing purposes was saturated with 90 per cent. benzol.
Class No. 1 meters are non-dipping. Class No. 2 and No. 3 meters are dipping.

Having obtained the above summaries of meter proofs, a comparison of which show the marked tendency for meters proved with air to show faster proofs than do meters proved with gas, or with saturated gas, it became necessary, in order to determine the comparative merits of the proving mediums employed, to endeavor to determine which gave the closest to the actual proof of the meters at the time of passing gas just previous to their removal from the consumers' premises.

With this object in view, ten 5 light meters, that had been in constant daily service at one location for a period of 7 months, each meter having passed about 24,000 cubic feet of gas during that time, were selected. These meters were tested with gas immediately upon removal, and under conditions both as to gas used and as to temperature, as near alike those under which they operated previous to removal

affecting the volume of the proving medium, the condition of the diaphragms, valves and exposed bearing surfaces, and the temperature of the proving medium, one way or the other, to affect the proof obtained. If, on the other hand, an unsaturated gas is used as the proving medium, and the meter under test had been operating under conditions which caused a drying action to take place inside of same, or in case the gas under which the meter had operated in service had been saturated to the same or lesser degree than was the proving medium, little or no change in conditions which would affect the proof of the meter would take place.

With the use of illuminating gas, suitably saturated at proving room temperature, no change in the volume of the proving medium, or in the conditions of the meter under test will occur, owing to the fact that, unless a change occurs in the temperature of the proving

medium during its passage through the meter, it will not deposit any vapors, neither will it pick up any, for the reason that it is not hungry for any vapors which the meter condensates may be prepared to give off, and so long as the temperature does not change there is but small probability of the liquids contained in the meter absorbing any vapors from the proving medium passing through.

The use of benzol, for the purpose of saturating the gas used for proving meters removed from service, it would appear, does not meet all requirements, inasmuch as it is a simple hydrocarbon. The gas needs to be saturated before entering the prover, with all the various hydrocarbon vapors, and with the water vapor which it would otherwise tend to pick up in passing through the meters under test. Meter condensation, used for the purpose, did not thoroughly saturate the gas passing over same, the reason being that the supply of condensation was only renewed at intervals, and being at the same temperature as the gas, it would not volatilize rapidly enough to completely saturate the gas. After carefully considering the question, it was decided to try the experiment of using both water and street main drip oil, the gas, together with the water and the drip oil, to be passed through a vaporizer heated to a constant temperature by boiling water contained in a water jacket.

An apparatus was constructed along the lines proposed. Gas was admitted to the vaporizer, or saturator, at the rates of 200 and 600 cubic feet per hour, after the water in the jacket surrounding the saturator had been raised to the boiling point. Water and drip oil were dropped into the saturator through a sight feed. The gas left the saturator at about 200° F., and after passing through a tin condenser, and about 20 feet of piping, it again attained the temperature of the surrounding atmosphere, but was found to be over-saturated with water and hydrocarbon vapors. The excess vapors carried by the gas in the form of a mist were quickly deposited, however, in flowing through an additional 10 feet of piping. By means of this inexpensive and efficient apparatus it is possible to completely saturate the gas at the temperatures at which it may be required for use in proving meters. No further experimental work has as yet been done, using gas saturated by means of the apparatus just described. Steps, however, are now being taken to equip all of the proving rooms of one of the largest gas companies with the apparatus, and to use saturated gas in proving all meters removed from service.

It is, of course, self-evident that the matter of constant medium is only of importance when testing meters; *i. e.*, when the adjustment or accuracy of registration of a meter is being determined by comparison to an accepted standard measurer, such as a meter prover. The important thing at such a time is that whatever volume is taken as a means of making comparison, it shall remain the same when measured by the second instrument (the meter), as it was when measured by the first instrument (the prover). In the practical use of the gas meter for registration purposes the question of saturation is of no concern, except as to harmful effect on the diaphragms or working parts, for a meter testing correctly will register correctly the volume passing through it. That is to say, 1,000 cubic feet of gas passing through the meter will show a registration of 1,000 cubic feet on the index, irrespective of whether that gas was fully saturated or but partly so at the time of its passage through the meter. It is only, as has been said before, where one gas measuring instrument is compared to another, as in testing meters, that it is essential that there be no physical change in the volume as measured by the first prior to and until after it has been passed through the second instrument.

From the experiments made it would appear that the use of gas for proving meters is conducive of more accurate results. It is unquestionably of less injurious effects on the interior of the meter, and also of better argument upon the subject, than is the use of air for the purpose. At least 3 of the largest gas companies are now using gas for the purpose of testing meters upon their removal from service, and another large company is preparing to use saturated gas for the same purpose. With proper ventilation, the use of gas offers no more objectionable features than does the use of air, while as a matter of fact the danger is reduced, inasmuch as the meters when proved with gas do not contain explosive gaseous mixtures, while meters proved with air do contain such explosive mixtures.

The injurious action of air upon the interior of gas meters which have been in service is well known; it would, therefore, seem advisable, in connection with using gas or saturated gas for obtaining proofs of meters, to make all tests to which the meters may be subjected in the meter shops with gas, taking every precaution to exclude the air from the meters at all times.

The average volume of gas used in purging and in obtaining one proof of each meter proved with gas, in the practical testing of meters on a large scale, as previously covered in this report, was 5.36 cubic feet. The entire cost of gas, labor and material required in preparing a saturated gas for use in obtaining the proof of consumers' meters, should not average, it is estimated, more than ¾ of a cent per meter proved. This cost would be offset and, in addition, an increased revenue would be derived as the direct result of testing and adjusting the meters under saturated gas. Meters proved with gas, saturated with meter condensation, showed a proof of 1.50 per cent. slower in the case of non-dipping, and a proof of 0.32 per cent. slower in the case of (Class No. 3) dipping meters, than they did when proved with air. Our experiments have shown that the use of saturated gas enabled proofs to be obtained which closely agree with the actual proofs of the meters while in service, and that air gave proofs which differed to a marked extent from the proofs in service. It would, therefore, seem reasonable to assume that, when using air, the non-dipping meters showed a proof of 1.50 per cent. faster than the proof under which the meters operated under actual service conditions, and that the dipping meters showed a proof of 0.32 per cent. faster. This being true, it would follow that, in adjusting meters using saturated gas, this fast error would be eliminated, and the meter so adjusted would tend to be correct when again placed in service, while the meters proved and adjusted with air would tend to be slow, under service conditions, to the extent of the 1.50 and the 0.32 per cent. herein referred to.

The fact that 4 of the largest gas companies have decided on the use of gas, in one condition or another, for the purpose of proving consumers' meters upon removal of same from the consumers' premises, is worthy of careful consideration, especially so in view of the fact that at present no municipal or State regulation prescribes that gas shall be used for the purpose. Where careful attention is given to the question of meter proving, and accurate results are strived for, or where it becomes necessary for the gas companies to insist upon the use of a medium for testing meters which will insure more uniform consecutive proofs being obtained by the several municipal and State inspectors, illuminating gas, properly saturated with hydrocarbon and water vapors, it would appear, possesses the desired qualifications for use as the proving medium.

In view of all the various and complex conditions in connection with the operation of obtaining proofs of gas meters, all of which tend to introduce errors in the results obtained, we feel that it should be clearly apparent that extreme care is essential in testing gas meters. The most scientific and careful methods employed are productive, it seems, of only close approximations of the actual proof. There are certain rules and precautions, however, which it would appear from data presented should be observed in order to obtain the proof of consumers' meters, within the smallest degree of error, and which your Committee desires to cover in this report:

Meter provers should be carefully constructed and calibrated. The prover bells should be polished brass or copper, preferably copper, and should not bind at any stage of their operation.

Care should be exercised to avoid sudden changes in temperature of the air in the proving rooms, due to causes such as draughts, direct sunlight or to mechanical means of heating, Sources of heat should be located at a distance from the provers, and radiant heat sources should be avoided in attempting to heat the proving room. The air in the proving room should be kept highly saturated with water vapor.

When proving meters that have not been in service, the air used for the purpose should be thoroughly saturated, at proving room temperature, with water vapor. Gas, or preferably, gas which has been saturated with water vapor and with the complex hydrocarbon vapors, likely to be picked up in the meters, proved upon their removal from service, should be used for proving meters that have been operating under gas.

When gas is used for proving meters, the water in the prover tanks should not be entirely removed at any one time, unless it becomes necessary to do so in order to make repairs or alterations. When fresh water is placed in the tanks, it should be allowed to remain in contact with the gas for at least 12 hours before using gas in the provers for the purpose of proving meters. Special care should be taken to cap the meter outlets, immediately upon removal from service, and to keep the caps on the meter screws at all times, while the meters are in stock, except at the time of proving and testing the meters upon their receipt from the consumers' premises.

(*Continued on page* 146.)

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NEW YORK, MONDAY, MARCH 3, 1913.

[Official Notice.]

Annual Meeting, Indiana Gas Association.

Office of the Secretary, Indianapolis, Ind., Feb. 15th, 1913.

The Annual Meeting of the Indiana Gas Association will be held at the Claypool Hotel, Indianapolis, Wednesday, March 12th, and Thursday, March 13, 1913. The sessions will begin promptly each day at 10 A.M. The afternoon of Wednesday, March 12th, the members of the Association will go in a body to the Exhibit of Industrial Gas Appliance in the Indianapolis Gas Company's display room, 37 South Pennsylvania street, leaving the Claypool Hotel promptly at 1:45 P.M. The list of papers to be contributed and discussed is as follows:

"Workmen's Compensation," by Mr. O. O. Thwing.
"Benefits of Gas to the Public," by Mr. A. S. Cooke.
"Motor Trucks," by Mr. G. M. Dolley.
A paper by Prof. Frank Mathers, of Indiana University.

The Bureau of Information will present its report, including the correspondence which has been received and dealt with during the year.

At 6:30 on the evening of Wednesday, March 12th, there will be an informal dinner (no dress suits) at the Claypool Hotel.

Respectfully, Philmer Eves,
Secretary-Treasurer.

BRIEFLY TOLD.

February Meeting, New York Section, Illuminating Engineering Society.—The New York Section of the named Society and the Municipal Art Society held a joint meeting in the Galleries of the National Arts Club, 119 East 19th street, New York, the evening of Wednesday the 12th ult. The proceedings were directed by Mr. Laurel Harris, President of the Municipal Arts' Society; and amongst other notables present we noted Mr. Preston H. Millar, President of the Illuminating Engineering Society, and Mr. G. H. Stickney, Chairman of the New York Section. The topic of the evening was the timely one of "Municipal Lighting," with particular reference to street lighting and fixtures, municipal building lighting, and illuminated signs manipulation, as applied to New York city. And not only was the subject and its divisions timely, but it was debated in a fashion that reflected creditably and positively the value of such bodies, and the worth of their studies to the entire body-politic of this in many ways amazing center of a polyglot population. The subject was presented in its varying phases by these authorities: Mr. C. F. La Combe, Chief Engineer, Department of Water Supply, Gas and Electricity; Mr. Charles Roland Lamb, Ecclesiastical Architect; Mr. Arthur Williams, General Inspector, The New York Edison Company; and Mr. William Wentz, Vice-President, the O. J. Gude Company. The last named gentleman was the first speaker, who interestingly narrated the inception and development of sign lighting, in the course of which he attributed the gathering of the great throngs along upper Broadway, now actually known as the "White Way," rather to the advertising signs than from the designed street illumination. As a comparison he called attention to the relative pedestrain traffic conditions existing on upper Broadway and upper Fifth avenue during the night. Of course, he declared, it was unnecessary to assert that bright illumination showing various devices would attract the attention of and cause the presence of hundreds whose abodes were far from the actual scene of the night picturings. The next speaker was Mr. Arthur Williams, who amongst other things declared that New York really had the greatest White Way in the world, and that many large cities in Europe were trying to duplicate it, using this example as the model. Asserting that light meant safety, he quoted the once famous remark of the late candidate for the Presidency of the United States, that "One arc light was at least equal to one policeman." Mr. Williams further averred that the effect of the lighting on upper Broadway was not altogether due to the street fixtures and the panoramic features, but was largely owing to the concomitant window lighting. Nor was the latter altogether spectacular or for the benefit of the populace, in that the flood of illumination resulted in the doing of a thriving retail business, the profit from which more than repaid the shopkeepers for their expenditures on gas and electric account. Commissioner La Combe followed with a symposium on street lighting and fixtures, his lecture (for such it really was) being plentifully and intelligently accentuated by means of lantern slides. The lecturer said good service meant good lighting, wherefore the greater aid to success was traceable to the men in the power stations. The type and numbers of lamps in use in Greater New York he said could be thus recounted: Electric arcs, 19,180; incandescent electrics, 17,991; flaming arcs, 78; single-mantle gas (incandescent) lamps, 44,650; inverted gas lamps (on trial), 28; naphtha gas lamps, 1,816—respecting these, they were rapidly replaced in the parks by means of tungsten lamps. The work accomplished in bringing about better lighting conditions during the past 10 years, said the lecturer, had increased the total candle power, from 7 millions to 15 millions. Since 1904 the candle power of the gas lamps had been increased three-fold by changing from the open flame type to that of the mantle type. Commissioner La Combe declared that the progress made in the past 10 years had not been in any real or true sense appreciated by the public-at-large; but a different state of mind would be created were the city, but for a day, thrown back to the condition of 10 years ago. In fact one could fairly predict a riot as the result. The lantern slides showed the methods employed in the designing of street lighting, including various types of posts and poles, old and new, that had been and were being used. A glimpse as to the future in this respect was nicely illustrated by a series of examples of designs still inchoate or embryonic. Mr. Roland Lamb (the last speaker) took up the subject from a decorative point of view. Here, too, lantern slides were invoked to plainly show the special lighting features in respect of some of the prominent buildings and bridges during the Hudson-Fulton celebration. He said that the chief object of artificial illumination should be to dissipate the darkness of the night, wherefore the source of light was not of such eminent importance as was the effect produced or exerted. He declared that the temporary illumination of public buildings for festival occasions was merely an example of that which might be accomplished by means of permanent illumination in carrying out decorative features along such lines. Speaking of the future Mr. Lamb suggested that large lighting units might be carried over a city by the agency of aeroplanes, with the object of securing a better general distribution of light. He further put forth the suggestion that that which was wanted all the time was more light. And he thought it was an open question whether or not the intrinsic brilliancy of our light sources should be increased; but independent of that every person interested in good lighting would likely agree that a better distribution from our present sources would greatly improve our lighting conditions.

The Philadelphia "Gas Meeters."—The third monthly meeting of the Philodelphia Section of "The Gas Meeters," was held the

evening of February 15th, in the Continental Hotel. Mr. H. P. Dains directed the proceedings both from the presidential chair and in the Toastmaster's seat. After a very enjoyable dinner, during which music was much in evidence, through the instrumentality of the "Trilby Band," Mr. Dains introduced Mr. Jno. Gribbel as the speaker of the evening. Mr. Gribbel prefaced his address by congratulating the Section upon its growth, which he said was, without any other reason, ample backing for the statement that there was room for the "Meeters'" existence. The address proper was divided into two parts: First, the gas business; second, the gas men. Some of the points prominently spread noted that the advancement of the gas business to-day was largely in the hands of those in charge of its commercial division, and this he accentuated by suggesting that, great as the achievement has been in augmenting the use of gas for fuel, the field was still suggestively large and incontestably attractive in inviting, yes, commanding, further exploration thereof. He showed that while gas as an illuminator had raised immeasurably the value of life from the mere viewpoint of living, it nevertheless seemed to him that the advances in the fuel field would be at least as great, if not greater, in still advancing to longer lengths the value of living. For, surely, well cooked food and well warmed shops and living rooms must be conducive to greater longevity. And, then, as to the gas man, under whose direction this development and evolution have been registered, he was self made. To-day, however, the gas man was, by the instruction of the past and the education of the present, at the point where his progress should be even greater than that of his predecessors; further, the gas man of the future *must* have good capacity for betterment by teaching. Competent men, in any line or vocation of the present day, are not over plenty, and as corporations are largely judged by the men who administer their affairs, it behooves the capitalist to see to it that his representative men are no longer of the rule-of the-thumb type. The public is, at best, a queer agglomeration, and it may not be denied that frequently a corporation of the order not superior gets along better than one giving superior service *per se*, simply through the respective personal equipment of the two under comparison. The subject was handled as only a man of Mr. Gribbel's long experience in the gas field could handle it, and his theories were really more in the nature of cold, concrete facts. Mr. R. F. Pierce, responding to the call of the Chair, narrated a series of experiences that were timely and true. Then all enjoyed Mr. R. J. Rolston's very neat counter on the rather unlooked for squib of the Toastmaster, and his play on the words "Meeter" and "Meter" was well appreciated. Mr. Charles W. Hoy followed with a narrative that was altogether amusing, if not instructive. Mr. George W. Thompson, in his concise and precise way, told how the coming use of gas for heating would solve the vexed problem of house heating, recited the the value that came from the gas "Industrial Show" recently brought off at Chester, Pa., and freely expressed his views relative to the difference between the terms "instruction" and "education" as applied to the young men and boys now engaged in the lower realms of the industry. Mr. J. H. Mansur entertained the "Meeters" with a bunch of recitations and stories that materially helped towards establishing the merriment of the occasion, and causing a break in the sameness of the technical work. Mr. C. H. Ehrengeller also spoke tellingly on the gas man and the gas appliance, and the recessional was a piano solo, beautifully rendered by Mr. E. W. Coit.—B.

FIFTEENTH MEETING, NEW YORK SECTION, "THE GAS MEETERS." The Fifteenth Meeting, New York Section of "The Gas Meeters" was held the evening of the 27th ult., at "Kalil's," Park Place. When dinner was announced (6:30 P.M.) over 50 took their places at the festive board with Will. W. Barnes (Chairman) presiding. "Junius Pluvius" is seemingly the "Patron Saint" of the New York Section, for he was again on the job. How it rained? But, then, nothing can dampen the enthusiam of these meeters. Having discussed a splendid dinner, pipes were lighted, and the usual order of business taken up. The first item was the acceptance of the resignation of Mr. H. Thurston Owens as Secretary, whose appointment as Manager of the La Crosse (Wis.) Company obliged him to locate permanently in that city. The resignation was regretfully indorsed, with hearty wishes that his success in his new field would be pronounced. An election for his successor resulted in the naming of Mr. John M. Brock. Chairman Barnes then in well chosen speech introduced the speaker of the evening (Mr. F. D. Pembleton, Public Service Company, New Jersey), whose paper on "Making Sales" proved a spendid one. In fact many declared it one of the best on record dealing with this section of the commercial departmen t of any business. It will be printed in full in our issue for next week. The paper was briskly discussed by Messrs. J. P. Conroy, I. W. Peffly, A. F. B. Harraden, Allan Booth, J. M. Brock, Wm. De Freitas and M. F. Spear. The ability to impart to others successful methods of selling is a supreme one, but even if the author stated that he drew some of his ideas from a new source (that of phychology) he managed to detail them in a manner convincing his hearers that the thoughts were all worth while.

CURRENT MENTION—

WE are authoritatively informed that the Waycross (Ga.) Gas and Power Company has been incorporated, with these gentlemen as organizers: Ex-Senator George W. Deen and J. A. Cooper, of Waycross; Albert Fendig, Brunswick, Ga.; J. J. Farnsworth, Jacksonville, Fla.; and Edward L. Rieha, Baltimore, Md. At a Directors' meeting, held the last week in February, the officers chosen were: President, Mr. G. W. Deen; Vice-President and Manager, Mr. J. J. Farnsworth; Treasurer and Secretary, Mr. J. A. Cooper; and Mr. Edward L. Rieha (Baltimore), was appointed Engineer in charge of the construction of the plant entire.

MR. H. C. HIGGINS, of Centralia, Ills., President of the Tri-City Gas Company, recently made a trip to headquarters at Gadsden, Ala., and the result thereof is an appropriation of $25,000 for the extension of its main system. The authorities of Alabama City, having failed to allow the Higgins syndicate a suitable franchise, it was determined not to pipe that section.

THE Hamilton (Ohio) Utilities Company has been granted permission by the Public Service Commission to issue $150,000 as capital stock, the proceeds to be used in taking over the properties of the old Hamilton Gas and Electric Company, which corporation and its belongings were recently acquired by Messrs. W. E. Hutton, J. C. Thoms and Joseph Pierce, of Cincinnati.

MR. R. B. BROWN, since 1901, Chief Engineer of the Milwaukee (Wis.) Gas Light Company, has been appointed General Manager of the Milwaukee (Wis.) Gas Light Company, and is now actively exercising the duties of such position. Mr. Sheldon J. Glass, of course, remains as Vice-President, and the divorcing from the Vice-Presidency the duties of General Manager will give Mr. Glass greater opportunity to represent the Company along lines of policy development, which lines are in the hands of a master when they are in his hands.

THE annual report of the United Gas and Electric Corporation, for the year ended December 31, 1912, shows net profits amounting to $7,524,691, an increase of $301,199. The sum of $774,500 was assigned to the sinking fund.

THE Pittsburgh Section of the Illuminating Engineering Society held a meeting, the evening of February 21st, in the Seventh Avenue Hotel, that city. The paper for the evening was read by Mr. S. B. Stewart, Contracting Agent for the Philadelphia Gas Company, his topic being "Gas Lighting." His paper, although largely historical, was modern enough when the matter of mantle lighting was under consideration. In the brisk discussion that followed, a prominent speaker was Mr. H. H. Magdsick, of the Cleveland National Lamp Company.

THE proprietors of the Mohawk Gas Company, of Schenectady, N. Y., are planning the construction of a plant on the coal gas type, which will cost not less than $350,000.

LAST month, according to the decision of Judge Edwin F. Lyford, in the Springfield (Mass.) Police Court, the Springfield Gas Light Company was found not guilty of wantonly or negligently detroying shade trees, as charged by the City Forester of Springfield, to the number of 60. The Judge, in announcing his decision, stated that although there was no doubt that the trees had been killed by gas that had leaked from the Company's mains, the evidence in the trial case did not establish beyond a reasonable doubt that the damage was caused by negligence on the part of the Company. The case was first before the Court on September 23, 1912, but continuances, and a great mass of testimony presented caused the trial to extend over a long period. It is worthy of note, too, that the instance of each tree was considered separately.

MR. EARL Y. COKELEY, well-known to gas men in the center of the State, has resigned the position of Treasurer of the Van Curler Opera House, to accept a place on the roster of the Schenectady Illuminating Company.

(*Continued from page* 143.)

All other accepted practices, as now embodied in present day meter proving in properly equipped and efficiently managed meter shops and proving rooms, should be very carefully observed.

Gas Light, a Hygienic Element for the User.

[Prepared by Mr. Warfield Webb.]

Aside from its many other admirable properties, gas, as used in the illumination of the home, or office or public building, acts as a factor for health. In other words, it is an agent for greater hygiene, and this statement alone should be of value to every worker or resident. Within a few years many of the busy ones have been so engrossed over hearing of the wonders of electric light, and of the superiority of such power for illumination, that they are apt to forget some of the more important points that gas light offers.

There are to-day three very essential considerations for every thinking man or woman who has his or her interests at heart to keep before the mind. The demand for artificial light has caused many to strain their eyes and they have been compelled to adopt long before natural time glasses when reading, if not for general use. The congestion, arising from our present day methods of living, has been in many ways detrimental to health, and the buildings wherein we live and work are more or less polluted with bacteria. The two former have combined to make the third, and there has been a lessening of the warning that too much reading or the use of too much bad light, in surroundings that are not up to the hygienic standard, is calculated to work disaster to our welfare.

To obviate these evils as far as possible there is need for greater breathing room permitting more light or natural light, and in this way making possible the admittance of a larger share of fresh air, and counteracting in this way the germ life that worked harm to us through affecting our health. However, it is not possible to do this, in a very large number of cases, so the alternative is to adopt such methods of lighting and purification as will assist in counteracting these evils. Scientists have proven, after many exhaustive tests, that the most sanitary, as well as the most hygienic light, making the above remedies possible, is gas consumed through the incandescent mantle.

This is a simple thing, and the remedy to offset the common evil of bad air in the building is readily explained. It has been found that gas light, under ordinary conditions, will give off a greater number of heat units than those from any other form of light. This added heat is the means of purifying the atmosphere in a room so lighted. The heat sets the air in motion, and the particles or germs that are continually arising, from several sources—viz., the breath of human and animal life, the dust particles that abound everywhere, the foulness stirred up from many causes—all are driven upward. The escape is through the ceilings and out the windows. With this poison driven off there is circulated the pure air from floors, lower sections of doorways and other openings; and in addition to the foregoing, likewise a considerable portion of this foreign matter is likewise consumed in the gas flame itself, which further adds to a purification of the apartment and its influence upon the system is of material benefit.

The methods of purification are used in laboratories where the operations demand a greater share of unpolluted air, and the use of a gas jet makes this possible and of easy operation. In acting as a regulator for the room gas has been found of material value. The heat particles rising permit the cooling of the lower portions of the room, and the temperature is thereby made more nearly normal and of far greater benefit to the occupant.

If we keep our living rooms and our working abodes free from foulness there is sure to be possible, not alone greater hygienic value to ourselves, and more comfort mentally, but we will be enabled to work with greater efficiency, and the labor will be freed from any of its irksome moments. The air in the room must be pure in order to make life livable; the sleeping apartment must be free from pollution, if our rest is to be beneficial and the standard of health maintained.

The doctors tell us now that there is nothing else so valuable to man as pure air, day and night. We are told that it will be impossible to maintain our health without this in abundance. Gas light will do much to assist in the purification of the air, which fact, so little known and so little taken into consideration during these days of hurry and supposed advance, that the campaign for gas in this way should be materially increased. It is a matter of education, and the public, becoming so wedded to the use of electric light, should be taught the value of the gas light as a hygienic power.

But this is not all. The other important question of eye-strain, paramount in importance to the matter of hygiene, is to be noted with due consideration. The diffusion of gas light from the mantle is the most restful to the eye that has thus far been discovered. It being free from glare, mellow and easy to read or work by, has been proven of the utmost significance to the user, whether such be one who uses the light only one hour or a number of hours.

The eye is a highly sensitive organ. It is so delicate that it demands the most particular care to keep it from becoming injured. The glaring light will do much to injure good eyes and material harm to the weak eye. The ultra violet ones are those so injurious to the eyes, and prolonged tests made prove that gas is freer from these rays than is any other light.

The subject of gas, as a lighting agent, demands a greater amount of thought. The public is not being educated in this way as it should and does demand. The gas light subject, in offering an improved hygienic value and a panacea for the common eye strain, should be one of the strong arguments for the gas man to offer, and one that can be borne out by actual tests made by authorities who are reliable and whose voice should become known with greater heed by the public.

[Official Report.]

FORTY-THIRD MEETING, NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

Held in Young's Hotel, Boston, Mass., Feb. 19 and 20.

The Forty-third annual meeting of the New England Association of Gas Engineers was held at Young's Hotel, Boston, on Wednesday and Thursday, February 19 and 20, 1913, under the Presidency of Mr. D. D. Barnum of Worcester, Mr. N, W. Gifford, of East Boston, being Secretary. The President called the meeting to order at 10 A.M., Wednesday, and announced, that the minutes of the last meeting having been presented, the reading would be dispensed with. He then called for the

Report of the Board of Directors.

The Secretary read the report as follows: Mr. President and Gentlemen of the Association: Your Directors report they have examined the following applications for membership and recommend their election to active membership:

Active.

Cullen, D.M., J., Pittsfield, Mass.	Luther, W. J., Attleboro, Mass.
Daton, A. W., Stamford, Conn.	Perkins, R. W., Woonsocket, R. I.
Hunter, C. W., Boston.	Royce, F. P., Boston.
Lindsey, New Bedford, Mass.	Wheaton, J. S. M., Barre, Vt.

Associate.

Barnes, K. S., Cambridge, Mass.	Manchester, C. H., Providence, R.I.
Dressell, O. F., Lynn, Mass.	Ruckderchel, C., Woonsocket, R. I.
Hatborn, G. W., Lawrence.	Wells, F. K., Boston.

Goudey, G. W., Boston, Mass.

Your Directors also report that they have examined the following papers and recommend them for your consideration:

On "Accounting," by A. R. Patterson; "Notes on Chemistry of Gas Coal," by E. F. Wilson; "Coal Gas? Surely: but How?" by R. B. Brown; "Stimulating Gas Lighfing Business," by R. F. Pierce. They also recommend the lecture on "Electrolysis," by Prof. A. F. Ganz. They have also heard your President's address, and have approved it for your consideration. Respectfully submitted,

N. W. Gifford, Secretary.

On motion of Mr. Prichard, for the wish of the members respecting the report, the Secretary was authorized to cast the ballot for the applicants named for membership as read. [Seconded and adopted.]

The Secretary cast the ballot, so reported, and the members were welcomed to seats in the convention.

The Directors further recommend the acceptance of the resignations of 4 active and 8 associate members.

The President—To save time it is in order that a motion be made that the President appoint a Nominating Committee, that that Committee may report at the time of the election of officers.

Mr. Morrison so moved and the President appointed Messrs. Africa, Snow and Scranton.

President Brown then read the following

INAUGURAL ADDRESS.

Forty-two years ago the first meeting of the New England Association of Gas Engineers was held in Boston. How many men in that meeting are here to-day? It is quite safe to say that not one of them had the least conception that 42 years hence there would be a meeting such as we are holding to-day. The number of men, the subjects, their many ramifications are beyond anything that could have been conceived at that time.

If we turn our thoughts in the other direction, and try to prophesy the conditions in the gas business 42 years from to day, we are in a greater state of helpfulness than those gentlemen would have been at that time if they had been asked to say what the future would bring to the gas business.

The Association has always met in Boston, and for a long time at this hotel. I am a great believer in the established order of things, but I think the time approaches when we will have to consider having the meeting elsewhere. I understand this building is to be torn down and office buildings erected in its place. I know a great many of the members will be disappointed if they have to go elsewhere, but I think another year the Directors should seriously consider other arrangements for the annual meeting.

We now have a place where our books and records are deposited. While the space is small, it is adequate at present. It is quite necessary for us to have some such place to preserve the books and records for, although they are seldom used by the members, the time is surely coming when they will be valuable property, and of great interest. Until such time comes they should be well preserved, and to that end the Directors have purchased bookcases to hold the new publications that have come into our hands during the last few years.

The precedent set by Mr. Snow (and followed by Mr. Coffin) of accepting the office of President for one year, I consider a wise one, and I hope to see it followed in the future. After a President does the work he should do in giving his time to obtaining papers and arranging for the discussions, he will have done all that can be expected of one member, and the Association and the meetings will benefit thereby if a new man undertakes the work each year.

General Policy of Gas Companies.—In days gone by, when the business was comparatively small, it was considered that we sold gas, but since this commodity has passed from a luxury to a necessity, we must look upon our business as selling service, and such service should as far as possible meet the demands of the public. We should aim to give the public what they want, when they want it and as they want it. We should have clear records to show what such service costs. When the public get what they want, and can be satisfied that the price is a fair one I believe they are willing to pay the price. Such a result as this, a satisfied constituency, would place the gas companies in an impregnable position, would safeguard the investment and assure the investors a fair return on their money.

Accounting.—When gas companies were formed in New England in years gone by, the men elected to directorship in the various companies were men prominent in business affairs in their respective cities and towns, and they naturally recommended the same policies for the gas company that had been successful in their personal business. This policy was dictated by the custom of the times, and was considered conservative and thrifty. In the majority of cases this policy was to keep the capital stock down and the plant up, and to charge off various amounts so that the book value of the properties was smaller than the real assets or physical valuation. No criticism can be made of these gentlemen for having carried on their business in this manner in the past, but the times have changed and the result of this policy, in the light of modern legislation, custom or ways of doing business, is that a great many gas companies find themselves in an embarrassing position.

The companies to-day, especially in Massachusetts, find themselves with a capital stock of say, roughly speaking, ½ of what their physical valuation would show, and it is not practicable for them to pay sufficient dividends on such a low capitalization as will constitute what the Supreme Court considers a fair return on the amount of property invested.

In considering how this fair return on the amount invested may be regulated for the future, we must remember that we are facing increased taxes, increased insurance charges, increased cost of material, an ever increasing charge for labor, and a public clamoring for more service for the same money.

This condition of affairs has to be met fairly and squarely by all concerned; namely, the stockholders, the regulating autho rity, the public and the employees.

The employees must be paid a fair and just wage. They must be paid the going wage for their class of work. We are bound to pay the market price for raw material. The law requires that we pay taxes and insurance, and the Supreme Court says the stockholders are entitled to a fair return on the investment. This must all be paid for by the consumer, and to meet these various problems and questions the first step is to show the facts and the amounts of these various charges.

In order that these various factors of the complicated problem may be intelligently studied and considered it is absolutely necessary that we begin with a comprehensive, complete and adequate system of cost accounting and bookkeeping. We must have these figures and facts for the benefit of the regulating authorities. We must be able to show the directors of our company, month by month, what we are doing and why we do it, and if we have new construction to be done, we must be able to show them the necessity of it and how we can pay the interest on the expenditure. We must be able to tell each month the cost of each operation, whether it is economical or extravagant, so that the manager of the company will know where to expend his energies to the best advantage. A manager should not depend upon memorandum, or he should not be obliged to work out these figures by memorandum. They should be presented to him each month in a concise and complete form that he may tell at a g lance where he can best spend his time to the advantage of the company.

A comprehensive system of accounting is the m ost effective instrument of offense or defense in the controversies which are bound to come to us in solving the aforesaid problems. We have to be able to defend what we have done, and we have to be able to prove what we want to do is right, just and economical and for the benefit of all concerned.

A system of accounting should be complete, but it should not be burdened or overloaded with red tape. At one extreme we have the man who says, "I received so much money; I spent so much money; and I have so much money left in my pocket." "I know what that is; what's the use of any books?" At the other extreme we have a system that is so complicated that we find the business conducted to suit the bookkeeping. It should always be remembered that the books should be made to fit the business. The main object of these books is to show the true cost of the commodity. The operating account must show the cost of each operation. It must show all material and labor actually used that month in each particular operation. It must show the annual payments such as taxes, insurance, etc., prorated for the month, and above all things it should be carried in such a manner that it may be handed to the man responsible, early in the month, so that it will be of value to him in directing the work for the following month.

When the Supreme Court decides that the investor is entitled to a fair return on the actual value of his investment, it also decides that the investor has the right to insist that the safety of his investment shall be maintained and not allowed to waste away through wear and tear, obsolescence or inadequacy.

When a public service corporation is under investigation this factor of depreciation is the one that causes the most argument. To discuss this subject intelligently for any particular company, it is first necessary to make a complete inventory and classify the items, and then, taking into account the physical decay, ascertains how soon it will be too small for the business, how efficient it is compared with new apparatus, the care which it has received, the intelligence with which it has been designed, the growth of the city and many other factors to determine how long before it will have to be replaced. This being done, we still have the financial problem of providing the money at the required time. In Massachusetts a public service corporation hardly dares to have a reserve fund for depreciation, emergencies or working capital.

In New York the Commission says you *may* carry a Depreciation Reserve Fund. While in Wisconsin the statutes of the State require that the companies *shall* carry such a fund for the future protection of both the company and of its consumers. This is significant and rather indicates the trend of the times.

In considering the charge for depreciation we must at the outset realize that depreciation is as much an expense as material or labor used from month to month. It may not show up but once a year or once in 20 years; but it is there, and has to be paid for by the consumer, and the latter in the year 1913 should pay for the actual depreciation in 1913, even though the actual replacement may not take

place for 20 or 50 years. This is such a large subject that I will not undertake to go into it. I wish to call your attention to a book published by Dr. Humphrey's, entitled, "Lecture Notes on Some of the Business Features of Engineering Practice," where this subject is dealt with in great detail. One factor in this matter of accounting has been very much underestimated, and comes in the question of valuation of a plant. This is the question of the proper amount to be allowed in construction work for over-head charges. It has always been a hard matter upon which to obtain definite figures and facts, and I think it will be found that few of us have realized its importance. For instance: At a recent hearing before the Wisconsin Commission it was testified to, by an officer of a large engineering and contracting concern, that in $51,000,000 worth of work they figured 36½ per cent. for overhead charges, and another engineer testified that on the last $8,000,000 worth of work that his concern had done, it was 30 per cent.

With our books as they should be, and the proof of the facts shown by accepted methods of accounting and bookkeeping, and with honest intentions to treat the comsumer, the employee and the stockholder with perfect fairness, it does not seem to me that the problems ahead of us are insurmountable.

Coal Gas.—The gas men of New England are probably facing the most serious engineering problem that they have had to consider for a great many years. During the last 10 years the consumption of gas has increased 122 per cent., and most of this increase has been taken care of by water gas generating apparatus. This could be done on a small investment, and, with oil and hard coal at the prices which have prevailed during the last 10 years, the gas could be made economically, and the water gas apparatus was a convenient adjunct to the coal gas plant. The labor was low and such apparatus could be started or shut down with very little trouble. In addition to the above, with the old-fashioned coal gas plant, the labor was high, the quality uncertain and close to the statutory limit, and the coke was of indifferent quality.

The factors in the problem have undergone radical changes within the last 5 years. Hard coal has advanced materially and gas oil has doubled. On the other hand, with coal gas, the cost of labor has been reduced to where it compares favorably with water gas. The quality of the coke has been improved to a point where we can say *that gas and coke from bituminous coal are the logical solution of the fuel problem for New England.* In fact, New England could and should be independent of the anthracite coal situation. Furthermore, the quality of the coal gas made from the modern retort house can be controlled and maintained above all reasonable statutory requirements without enrichment. In the modern way of building machinery, with special material for special uses, and with "clean design," the repairs and maintenance of the modern retort house are far below the old figure of 10 years ago. For example, take our experience with the Worcester plant. We started the house October 1st, 1908. Those retorts ran until February 1st, 1913, 1,580 days, each retort having made over 24,000,000 cubic feet of gas of a very high yield, with high candle power and high heating value.

You cannot expect to have a much reduced price in either gas oil or hard coal for some time to come. Gas coal may and probably will increase somewhat, but not enough to be a material factor in solving the problem. To my mind the key to economical gas making in New England in the next 10 years is the manufacture of coke that will compete with hard coal.

Deceased.—It is my sad duty to report the deaths of 7 members of our Association. They were our friends and to them as pioneers in our life's work we owe the present standing of an industry.

The patience, perseverance and will power that they demonstrated by their upright lives are bright beacons which we inherit from them. I will appoint these gentlemen to serve as Committees on Resolutions, as named:

Deceased.	Committees.
Mr. C. M. Coburn	H. A. Norton and B. J. Allen.
Mr. E. H. Yorke	W. G. Africa and C. F. Prichard.
Col. F. S. Richardson	C. J. R. Humphreys and S. J. Fowler.
Mr. E. C. Learned	C. A. Learned and J. A. Norcross.
Mr. H. F. Coggshall	W. A. Learned and C. F. Spalding.
Mr. J. R. Todd	N. W. Gifford and Wm. Anderson.
Mr. M. Leavenworth	D. T. Cortis and Fred'k Wells.

(To be Continued.)

MR. HENRY W. BENNER, Superintendent of the Chambersburg (Pa.) Gas Company, since 1907, has resigned from the service.

Giving the Customer a Wrong Impression.

[By MR. ALFRED F. KRUG, in "Baltimore Gas and Electric News."]

In cases where the bookkeeping department fails to place the correct dates on the face of gas bills the commercial department is required to make a full explanation to customers should they call at the office. Such cases often require a great deal of explanation. The following is a case recently handled by the commercial department.

For the past 14 months this Company has had difficulty in reading the monthly indexes of a gas meter, due to water in the cellar. The customer called at this office and stated he had been charged twice for gas, and presented his bill as rendered by this Company to substantiate his statement. We found upon referring to our records the following: On October 7th, 1912, (regular reading date) index was read as 525 and a bill rendered for 30,100 cubic feet of gas. On November 7th, the next regular reading date, our meter reader could not read the index, due to water being in the cellar. Several calls were made later, but the index could not be read for the same cause. Instead of rendering a two months' bill to this customer a bill was sent out as follows:

November 14th	Water
October 7th	525
Estimated	29,100 Cubic Feet

Estimated index 816 appeared on ledger in red ink (not in the meter reader's book) and the consumption of 29,100 cubic feet as shown above is obtained by subtracting the index 525, read on October 7th.

The next regular reading date for this meter was December 7th. On account of water in the cellar the meter reader again failed to read the index of the meter and not until December 27th was our meter reader able to read the index. The index was read as 359 and a bill was sent out as follows:

December 27th	359
October 27th	525
	83,400 Cubic Feet
Less estimated bill of November 14th	29,100 " "
	54,300 Cubic Feet

The estimated bill for 29,100 cubic feet was paid by the customer without any question. When he received the bill for 54,300 cubic feet, dated October 27th to December 27th, he could not understand the bill as he stated when he called at this office that this Company had already rendered him a bill from October 7th to November 14th. This bill he had with him. The customer at first did not understand the explanation made to him by the clerk and it required 30 minutes for the explanation. Had the error been discovered by the bookkeeping department before the bill was sent out the customer would not have been inconvenienced by calling at this office for information and the clerk would not have lost 30 minutes in making the explanation. The billing dates should have appeared as follows:

December 27th	359
October 7th	525
	83,400 Cubic feet.
Less estimated bill of November 14th	29,100 " "
	54,300 " "

The correct date was placed on the customer's bill by the clerk in the commercial department. The customer stated that a pair of gum boots were purchased by him for the purpose of loaning same to our meter readers when they came to read the index of his meter, and if they had followed the instruction to remove their shoes and put on the boots they would have been in a position to read the index regularly each month. He stated that some of the meter readers used the boots, others refused to do so. Instructions have been issued to change the position of this meter from the cellar to the first floor.

AT a regular monthly meeting of the Orangeburg (So. Car.) City Council, held some evenings ago, one of the matters that aroused considerable interest was the submission of a petition, by Mr. E. L. Rieha, of Baltimore, Md., asking for the right to operate a gas plant in the named place.

Special English Correspondence.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, Febuary 10, 1913.

The Half Year Accounts.—Increased Sales on Increased Costs.—The Present and the Future of Petroleum.

The two leading London gas undertakings have issued their reports of statements of accounts for the half year ended December 31st last. The most striking feature is the increased sale of gas, from which it may be concluded that the wave of commercialism that has been such a prominent feature with us of late, has extended beyond paper limits, and is not confined to mere talk. It is evident that while the undertaking, *minus* a properly worked sales department, may do well, the one that seeks to do business on modern hustling business lines *will* do better. Some 40 years ago I remember having a chat with an old gentleman who had retired from a fairly prosperous business. He had finished his career—I was just beginning, and was looking out for some helpful information. Amongst other things he boasted "that he had never solicited an order," and it struck me at the time that this remark fairly represented the policy of the gas business, as then conducted. Suggestions to the effect that a sales department was needed were at that time received with ridicule, and an intimation that a day would come when ordinary commercial practices would have to be adopted were received as one of the fancies of a young, inexperienced man. To day the selling department is taking the first place. As Mr. James W. Helps remarked in a presidential address, if there are no sales, there will be no need for engineers, chemists, new processes, etc. And as a practical result, we find the Gas Light and Coke Company recording an increase of 7¼ per cent. in gas sent out, as compared with the corresponding period for 1911, and South Metropolitan a good 6 per cent. The weather, it should be remarked, was unfavorable rather than otherwise. The general experience of the last few years is very little severe weather before Christmas, and in fact we do not get any winter till the spring. So there has been no specially cold or foggy weather to create an abnormal demand. The increase is due to commercial methods of getting at the customer. A small proportion, not 1 per cent., is due to public light. The bulk is for ordinary consumption. It may be suggested that for some years past there has been a shrinkage in consumption of gas, due to the substitution of the incandescent for the flat flame burner, which has had the effect of marking the growth of the business, and that the shrinkage has now taken its natural bearings. Taking this point for all it is worth, it does not alter the importance of the increase above mentioned, which is the more evident if, instead of talking in percentages, we take the concrete quantities. The increase for the Gas Light and Coke Company is 914 million cubic feet of gas and for the South Metropolitan 382 millions. The Gas Light and Coke Company have been extending at the rate of 5 millions and the South Metropolitan 2 millions per day. Incidentally it may be observed that the Gas Light and Coke Company have put out on sale or hire 36,430 gas stoves in the 6 months. This is too big to be accounted for by any favorable combination of fortuitous circumstances.

Another point that is prominent in the accounts, is the effect of the residuals in acting as a sort of financial balance wheel. Both Companies complain of increased coal bills. After allowing for increased make of gas, the Gas Light and Coke Company have to face an increase of about £130,000 in the cost of coal, and a very large proportion of this sum was recovered on residuals. The South Metropolitan show an approximately proportionate increase, and in their case also, the residuals will pay the greater part of it. We have again found that increased price of coal means a brisk state of affairs in the general trade of the country, in which the demands for tar and ammonia participate, while coke naturally tends to move in sympathy with the price of coal. And so it is that as a rule a gas undertaking can contemplate a moderate advance in the cost of coal, provided such is natural, and not the result of agitation or combinations, without much apprehension, and that under such circumstances they can continue to sell gas at the same price and to pay the usual dividends. I have given prominence to the increased sales of gas and cost of coal, because they are not peculiar to the two concerns specified, but to some extent indicate the state of affairs all over the country.

Increased cost of coal is not the only difficulty. Coal has gone up perhaps 10 per cent., but metals of all kinds, iron, copper, lead, tin, more than 20 per cent. The result is apparent in the increased cost of repairs and renewals of all kinds, and in that of stoves and appliances put out on hire. Cookers and gas fires as a rule are let out at the lowest renumerative rates, in order to obtain the consumption of gas. So a rise of 20 per cent. in cost hits the company with a large hiring business pretty hard. But I have not heard of any undertaking that has as a consequence raised the rent charges. The general experience is that the increased sales of gas and of residuals are sufficient to cover the extra cost, but in some cases a moderate draught on the balance of undivided profit is necessary.

Each year seems to bring an increase in the value of residuals, and this is so noticeable in the accounts under notice that evidently we are getting within measurable distance of the time when gas will have to look to its laurels as the primary product and most important item on the income side of the balance sheet. Dr. Davidson, of Birmingham, in the course of a recent discussion on yields per ton of coal, claimed that the make of gas was not the chief consideration, and expressed a preference for more tar and less gas. And it is notable that the Birmingham Gas Committee are now contemplating a large extension of coke ovens to replace used out retorts and settings. In the last year ended 31st December, 1911, the Gas Light and Coke Company expended on carbonizing material about £636,000, and their receipts for the corresponding period for sales of residuals were £496,000. For the same period in 1912, with a large rise on the price of coal, the materials cost £803,000 and the residuals realized £598,000, the last named sum being more than one-third of the receipts for gas. This Company makes about 16 per cent. carbureted water gas, or one part to six of coal gas. And when we turn to the South Metropolitan Gas Campany, who make straight coal gas, the point is still more prominent. They spent about £395,000 for coal, and received for residuals £321,000, being nearly one-half of the amount received for gas. This is by no means an exceptional case, for I could mention several examples in the provinces of concerns receiving for the sale of products nearly one-half of the income from gas. From which it is evident that the term "Gas Company" calls for some revision.

A remarkable feature in connection with the South Metropolitan Gas Company is the preponderance of slot meters. There are many concerns in which this variety of meter far exceeds the ordinary, but the South Metropolitan have on hire 95,898 ordinary meters, and 263,913 slots, a ratio of 1 to nearly 3. They may well have workmen directors, considering such a large amount of business is done with that class. Also there does not appear much chance for a gas stove canvasser, however smart, to make a living in the district south of the Thames, seeing that of the ordinary consumers 5 out of 6 hire a gas cooker, and the slot users are not far behind. A somewhat whimsical item in the "expenditure" is "stolen from 3,553 slot meters broken open £281," from which it appears that the business of surreptitiously opening the meter when nobody is looking is fairly safe, so far as the police are concerned, but not very remunerative. Apart from the direct labor, there is some loss of time waiting for a favorable opportunity, and probably a watching confederate who expects to go halves, An average of 1s. 8d. per meter does not seem a large profit, and perhaps that is the reason for advertising the robberies in the accounts. The light fingered gentry may be induced to direct their abilities in other directions. But the number of robberies, about 1 to 750 meters, is fortunately a most unusual experience. I am directly interested in some 5,000 slot meters, and a robbery is the exception. The total number in all, over 15 years, is only half a dozen or so. In one instance a respectable looking elderly gentleman, with a heavy grey moustache, visited the district and made some dozen attempts to get access to the slot meter, on the plea that he came from the gas office. But not being provided with the uniform lettered cap worn by all the outside employees of the Company he was received with suspicion, and was not successful in any case. Possibly he has now joined the band that appear to be exploiting the South London district with fair success.

Some of the suburban companies show increased sales for the 6 months that are simply phenomenal. The Tottenham Gas Company supply a large district on the north side of London, and their increase is 13 per cent. Brentford on the west side has an increase of 10 per cent., and Kingston, a southwest district, 9 per cent. And while the usual experience in residential districts that have not expanded or grown, is 5 to 6 per cent., there are many instances of 10 per cent. or more in the provinces. Coatbridge, in Scotland, records 14 per cent.

Prof. Vivian B. Lewes has recently delivered a series of three lectures on liquid fuel before the Society of Arts. The selection of the subject was no doubt suggested by the effect of the coal strike in directing attention to substitutes for coal, that are more portable and

can be stored without fear of loss by depreciation or spontaneous combustion. The first lecture dealt with the origin of petroleum, and Prof. Lewes considers that the chief source of mineral oil was marine vegetation, which under the conditions existing at the time of formation, probably grew in shallow seas, with far greater rapidity than anything in the experience of the present age. At that time decay as we now understand it, was almost unknown, because the atmosphere contained so much carbonic acid and so little oxygen that any such action would be much more akin to fermentation. Incidentally it would appear that this vegetation by absorbing carbonic acid and exhaling oxygen, prepared and rendered the atmosphere suitable for the support of animal and of human life. The true sea weeds contained no fibrous structure and were, therefore, least able to resist structural decomposition, and constituted the only form of vegetation that could conceivably be converted into oil and gases without leaving some kind of a sediment or residue, that would afford some idea of their origin. An oil field, however prolific, was only a natural storage tank for long dead manufacture, and the more districts were worked and the larger the quantity of petroleum extracted, the nearer we were getting to the inevitable end and exhaustion of the supply. The world's output of petroleum was now approaching 50 million tons a year. In the second lecture attention was directed to the practical results of using crude petroleum, or its various distillates, as fuel for firing steam boilers or in internal combustion engines. Actual results in practice showed an evaporative power from and at 212° F. of 14 to 15 pounds per pound of oil, or about 19,000 B.T.U. Blast furnace and tar oil gave about 12 pounds or 16,000 B.T.U. In the third lecture the Professor attacked the interesting question of how the enormous and continually increasing demand for petroleum was and could be met, and how long the world's supply might be expected to last. Dr. Engler had given it a life of 100 years, but the lecturer doubted whether in half that period oil would be obtainable at reasonably remunerative prices. From which it appears that in a very short time we may expect to see substantial advances in price, due to the beginning of the end, which would take the form of the exhaustion of one field after another, coupled with endeavors to hold up stocks in view of better prices.

Items of Interest
FROM VARIOUS LOCALITIES.

MR. THURSTON OWENS, Vice-President and General Manager of the La Crosse (Wis.) Gas and Electric Company, announces that Mr. J. A. Patton, formerly of Winona, is to act as General Superintendent of the corporation. Mr. J. M. La Vaque is retained as Chief Clerk and Cashier.

MESSRS. H. M. BYLLESBY & CO. report that the annual statements of the business done by its San Diego (Cal.) Consolidated Gas and Electric Company, as of 1913 and 1912, is represented by the following comparative figures:

	1913.	1912.
Gross earnings	$1,053,726.61	$771,840.95
Operating expenses	530,062.56	373,842.29
Net earnings	523,661.05	397,998.66
Interest charges	172,068.86	113,466.47
Balance	351,592.19	284,532.19

The consumers' rolls show these figures:

	Jan. 31, 1913.	Jan. 31, 1912.
Gas consumers	18,374	13,545
Electric consumers	14,762	10,307
Total	33,136	23,852

In this connection it may be remarked that, while these figures, as to both divisions of the Company's business, show remarkable growth, they also further emphasize the fact that the older section of the trading is at least "holding its own."

ANOTHER Byllesby recent happening was the annual meeting of the Mutual Advancement Club, of the Muskogee Gas and Electric Company. The following officers were elected: President, L. A. White; Vice-President, W. S. Reece; Secretary, C. W. Evelyn; Treasurer, F. D. Schaefer. Committees were appointed for these named subdivisions of the Club's activities: Executive, Programme, Question-Box, Entertainment, Publicity, Welfare, Membership, Pulmotor. The Programme Committee has outlined a plan of having a series of "short talks," the set papers to be considered at future meetings, the topics being connected mainly with the Accounting Division, as a starter. The Pulmotor practice has been demonstrated publicly several times, and the committee will report such exhibitions at frequent intervals. Amongst the more important papers recently read at Club meetings were: "The Attitude of Some People Toward Our Company," "Contract Department" and "Business Organizations."

"LITTLE HINTS," writes from Nashville, Tenn., under date of the 20th ult., as follows: "Generally on my travels nearly every gas man asks if I am still making that 'red mud' mineral paint. I don't seem able to get it out of their heads that we are really in the paint business, doubtless because of the fact that I was so long in the 'mud' business. Let them go on thinking I am making only metallic paints, as long as they note the fact that our New York office has just signed a contract to supply all of the paint required on the 16-story Architects' Building now being completed in New York city on Park avenue. Our Nashville contracts, including such buildings as the First National Bank, seem like 'pikers' after the first one noted. However, we still hold up our heads, and have shipped this week 100 gallons of holder paint to a man who has made the gas industry famous in the West; that is, to the always alert H. L. Strange, Manager at Honolulu, Hawaii."

THE Consolid ated Gas, Electric Light and Power Company, of Baltimore, Md., has entered into a contract with the Maryland Steel Company, to supply it with 6,500-horse power of electrical energy. This power will supplant the use of steam under the boilers of the Steel Company, and eventually the Gas Company expects to increase this contract to 20,000-horse power, thus entirely displacing steam power in the huge steel plant. The Company now is carrying out a contract with the Baltimore Copper Company, which requires current almost equal in volume to that which is being sent into the steel works. The steel corporation will use electric power in its machine, blast furnace, Bessemer open hearth, rail and by-products departments.

AT the annual meeting of the shareholders in the Laclede Gas Light Company, of St. Louis, the following Directors were chosen: C. L. Holman, Alonzo Potter, W. K. Bixby, Adolphus Busch, Murray Carleton, A. C. Church, D. R. Calhoun, C. H. Hutting, Rolla Wells, Edward Malinckrodt, Thos. H. West, James E. Smith and G. H. Walker.

"V.," WRITING under date of February 21st, says that an interesting and well attended meeting of the Gas Study Club, of Wilmington, Del., was held the evening of February 18th. Interesting addresses were delivered by Messes. Munchweiler and Hellar, of Philadelphia, the first talking principally on salesmanship, the latter on efficiency. Mr. John Black also read a paper entitled "Freeze-ups and No Complaints," which was followed by a very useful discussion.

THE City Commission of Pontiac, Mich., some days ago approved an ordinance providing for the inspection of gas and for the appointment of a city gas inspector and analyst. As the salary named for the job is only $600 per year it is likely the Pontiac authorities will have to employ a night clerk in and of some local Hebraic chemist and druggist.

IN order to determine the full strength of the "poet lariats" in the service of the Lloyd Construction Company, of Detroit, Mich., just write to them for a sample of the Company's latest mailing card having to do with spreading the light respecting "Lloyd's Varying Pressure Control." The "lariatist" could not have been "Billy" Guitteau, for he was East when the card came to our office. Of course it is possible that he composed the matter shortly after retiring to slumber in the Cadillac Hotel, New York, and "wired his lines" to the Lloyd Brothers ere sleep overtook them. We hope not, however, for the "lines" are simply dispiriting.

THE Lead-Deadwood (S. D.) Gas Company has been transferred to the Belt Gas Company, a new South Dakota corporarion with offices in both Lead and Deadwood. The Jamison interests have been entirely eliminated, and the real parties in interest seem to be Clinton S. Woolfolk, of Chicago, and associates. Mr. Henry H. Hyde is to act as Manager, and Mr. Walter V. Turner, formerly of the Northwestern Gas Light and Coke Company, Evanston, Ills., is to act as Engineer. The works will be reconstructed.

On Monday, Feb. 17th, the regular monthly meeting and luncheon of the Local Employees Association, of the Suburban Gas and Electric Company, of Revere, Mass., was held. The evening was given over to a practical demonstration of the Pulmotor, by Mr. C. E. Paige, of the Malden and Melrose Gas Company, and a demonstration also of the General Electric Ozonator, by Mr. Abbott, of the General Electric Company. This was attended by all the prominent physicians of Revere and Winthrop, and there was much enthusiasm amongst the medical fraternity regarding the use of both these appliances.

The referendum election, at which will be determined by the voters whether or not the terms of the franchise, from the City Council to the Bacon brothers, under which the latter have agreed to construct and operate a gas plant, has been virtually declared void, through failure to act within the specified time. Meanwhile the franchise for account of the Harrison syndicate will be voted on the 14th inst.

One evening last month a noteworthy demonstration of gas salesmanship and business getting was successfully brought off, under the direction of the Boston Consolidated Gas Company, in Union Hall, Boylston street, Boston. A large audience was present. With Clerk George F. Riley, acting as application clerk, a demonstration of receiving orders from a former customer, and from 2 new customers, was given with almost perfect attention to details. A. G. Bevals received complaints; L. J. Joyce sold a blast furnance; A. F. Hussy disposed of a gas kitchen equipment; Col. Frank L. Locke, President of the Union, and Mrs. Robert A. Woods, of the Business Women's Club, acted as customers. The layout was set with everything up-to-date in respect of a salesroom and selling force, and the articles bartered for were in full view of the spectators. Mr. N. C. Fowler, a Director in the Union's Course in Salesmanship, delivered a brief address, and President Locke, and Mr. E. N. Wrightington, Second Vice-President of the Boston Consolidated Gas Company, also spoke.

The Porto Rico Gas Company has been incorporated, to own, construct and operate a gas plant in San Juan, Porto Rico, which ancient city is rapidly becoming an exemplar of all that is moderm. This task will be carried out by the Public Service Construction Company (Mr. J. Alex. Mayers, Chief Engineer), 30 Broad street, New York. Contracts for the various parts of the plant are now being considered for letting. This enterprise is sure to be a successful "go."

The Gas Machinery Company, of Cleveland, O., has been awarded a contract for the placing of 4 benches of 6's, with through retorts and discharging machine, in the generating plant of the Muskegon (Mich.) Lighting and Traction Company. The retorts and settings are to be of silica material and the benches are to be provided with one radial brick chimney, the latter to be of sufficient dimension for future duplication of the generating apparatus.

The Massachusetts Board of Gas and Electric Light Commissioners on the 20th ult. filed, in the United States District Court (Boston), its answer in respect of the suit brought by the Haverhill Gas Light Company, for an injunction to restrain the Board from enforcing an order reducing the price of gas in Haverhill from 85 cents to 80 cents per 1,000 cubic feet. At a special session of the Court, a temporary injunction was granted against the State Board enjoining the latter and Attorney General James M. Swift from attempting to enforce the order which was to have gone into effect March 1st. In its answer, filed the 19th ult., the Board sets up the validity and constitutionality of its order. The Board denies that its order will have the effect of taking the Company's property without due process of law, in violation of the Fourteenth Amendment of the Federal Constitution, or that it will prevent a fair return on the investment of the Company. The Board further declares that the rate of 80 cents per 1,000 cubic feet will yield a fair return on the property actively and necessarily employed by the Company for public convenience. The Board specifically denies the allegation of the Gas Company that its property, exclusive of its franchise, is valued as a going concern at $920,000. It also denies the allegation that in other cities similarly circumstanced the price of gas is higher than in Haverhill, and points out that in Lynn and Worcester the price is 80 cents, and that the Charlestown Company, serving a population having an output a little larger than the Haverhill Gas Light Company sells, at 80 cents. The Board also states that the order, in its judgment, is fair and reasonable and sufficient to cover all reasonable expenses, a reasonable allowance for depreciation, and a fair return on the value of the property actively and necessarily employed. Attorney General James M. Swift presented the answer in behalf of the State. As our readers already know the Company has agreed to the prior order of the Court, and has filed a stipulation with the Clerk of the U. S. District Court, in Boston, agreeing to turn over all the moneys collected in excess of 80 cents per 1,000 cubic feet, pending the final determination of the case.

The Legislature of Maine has passed a special act enabling the authorities of the town of Sanford "to acquire, own, maintain and operate a gas plant, and for such purpose said town is vested with the power to raise money, as hereinafter provided, for the purchase or lease of lands, etc." It is also provided that "The building, equipping, care and management of said plant shall be under the control of the Selectmen; or if the legal voters of said town of Sanford, at its annual town meeting, or at any meeting legally called for that purpose, so vote, said duties shall be placed in the hands of the Commission, the members of which shall be chosen in town meeting as other municipal officers are chosen, and shall be known as 'Commissioners of Public Service.' If such Commission is chosen it shall then exercise the powers and duties herein before given to the Board of Selectmen for equipping and operating said plant."

Mr. W. J. McCorkindale, who will be recalled as the son of the late Mr. W. J. McCorkindale, formerly Chief Mechanical Engineer of the New Orleans (La.) Railway and Light Company, and later on will be remembered from his excellent work in connection with the reorganization of the Marquette (Mich.) County Gas and Electric Company—in fact he was Vice-President and General Manager of that cosporation until a few days ago—has resigned from that service to act as General Manager of the Wilmington (Del.) Gas Company. He is a clever gentleman and a competent engineer, and if good wishes count for aught, he will be a very successful man in his dealings on behalf of the Geist Company, who is the owner and operator of little Delaware's greatest gas plant.

The ordinances under which it was proposed to forthwith reduce the gas rate in Philadelphia to 80 cents per 1,000 cubic feet were vetoed by Mayor Blankenburg, in a message that is lucidity itself. The main impelling cause was that the measure did not provide means for obtaining a revenue equal to that now paid by the lessees by other fixed, steadfast means.

Gardner (Mass.) is not a very large place, nor is its Gas Company a huge institution; but that the residents are teachable and that the Company's new business agents are hustlers seem pretty well attested in this statement. January 1, 1912, the Company had out on its lines 387 gas ranges; January 1, 1913, the number was 467.

Mr. Karl S. Barnes, whose resignation of the post of Superintendent of Division 2, Boston Elevated Railway, to accept the post of Assistant to President and General Manager of the Cambridge (Mass.) Gas Light Company, was pleasantly remembered by some of the employees of the Elevated system who were under his direction. The evening of the 21st ult. possibly 100 of the men gathered at the Barnes home, and "surprised" the inmates of that mansion in true New England style. The delegation brought with them a beautiful example of a foyer and hall antique clock, which was duly presented to Mr. Barnes, with the compliments of the men. Mr. H. H. Hanson, Acting Superintendent, Division No. 2, Elevated Railroad, made the presentation, and Mr. Barnes was well non-plussed. However, he showed to better advantage later on, when supper was served, and when the speechmaking was on.

The proprietors of the Amherst (Mass.) Gas Company have announced that, beginning May 1st, these rates will prevail: Gas, per 1,000, gross, $1.40; net, less 10 per cent. for prompt payment—a minimum charge of 50 cents per month is also scheduled. Electric current, a reduction all round, amounting to ¼ cent per 100 kilowatt hours.

Mr. Louis F. Murray, formerly with the Salem (Mass.) Gas Company, has accepted a position on the force of the Marblehead (Mass.) Company.

At the annual meeting of the Public Service Company, of Northwestern Illinois, held in Chicago last Monday, the proposition to merge with the Northwestern Gas Light and Coke Company, was favorably voted upon.

The Market for Gas Securities.

The quotations for Consolidated gas last week were lower than those recorded therein for several months. At one time, early in the week, the figures represented a loss of over 5 points as compared with the opening of last Friday. Towards the close of the week a partial recovery was made, and this continued to to-day (Friday, noon), at which time the figures came in at 130½ to 131. The wars and rumors of war, together with the turning over of the direction of the affairs of the country to men altogether new to governmental practices, of course, are responsible for the great shrinkage in values that has been going on since the spring of 1912. However, it is but common fairness to give the newcomers a chance to prove themselves before reaching a verdict. The President is beyond doubt a clean man, and his clever administration of one of the greatest and best known seats of instruction in the country, and his subsequent handling as Governor of the affairs of the great State of New Jersey (for depite its territorial smallness it surely is a giant in commerce) all go to show that his methods are those of an upbuilder rather than those of a ranting reformer. No matter what he does, however, the stability of the entire gas industry of the country cannot be shaken. To our minds the quotations of to-day, respecting the large companies, will be cause for many sighs in the future from those who then read of 10 to 50 point advances.

Brooklyn Union is 129½ to 132; Peoples, of Chicago, is 110½; Laclede common is just below par—it should be at least 30 points above it; and Massachusetts common is 89½ to 90. The American Gas Company's regular dividend of 1¾ per cent. was made payable the 1st inst.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

115 BROADWAY, NEW YORK CITY.

MARCH 3.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked*
Consolidated Gas Co.	$99,816,500	100	130½	131
Central Union Gas Co.—				
1st 5's, due 1927, J. & J.	8,500,000	1,000	108	108
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	105	106
Mutual Gas Co.	8,500,000	100	173	177
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	101	102½
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	59	62
1st Mtg. Gold Bds. 5 p. ct.	1,500,000	—	98½	100½
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	103	105
Con. 5's, due 1945, J. & J.	1,500,000	—	96	100
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	99½	101
Standard	5,000,000	100	60	70
Preferred	5,000,000	100	90	100
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	103	105
The Brooklyn Union	15,000,000	1,000	129½	132
1st Con. 5's, due 1948, M. & N.	15,000,000	—	106¼	107
Yonkers	399,650	500	130	—
Out-of-Town Companies.				
Bay State	50,000,000	50	¼	5-16
" Income Bonds	2,000,000	1,000	—	75
Binghampton Gas Works	450,000	100	—	—
" 1st Mtg. 5's	500,000	1,000	97	100
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	83	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	8
Bonds, 5's	5,250,000	1,000	59	60
Capital, Sacramento	500,000	50	—	85
Bonds (6's)	150,000	1,000	—	—
Chicago Gas Co. Guaranteed Gold Bonds	7,000,000	1,000	104	106¼
Essex and Hudson Gas Co.	6,500,000	—	133	136
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Rapids Gas Light Co., 1st Mtg. 5's	1,350,000	1,000	100	101
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	—	136	138
" Bonds, 5's	10,500,000	—	104	106
Indianapolis	2,000,000	—	38	45
" Bonds, 5's	2,650,000	—	104½	105
Jackson Gas Co.	250,000	50	82	—
" 1st Mtg. 5's	290,000	1,000	91	
Kansas City Gas Light Co., of Missouri	5,000,000	100	—	96
Bonds, 1st 5's	3,822,000	1,000	98½	99
Laclede Gas Co., St. Louis.	10,000,000	100	99½	100½
Preferred	2,500,006	100	99	102
Bonds	10,000,000	1,000	102½	108
Lafayette Gas Co., Ind.	1,000,000	100	—	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	120	130
Madison Gas and Electric Co.				
" 1st Mtg. 6's	400,000	1,000	106	
Massachusetts Gas Companies, of Boston	25,000,000	100	89½	90
Preferred	25,000,000	100	94	94¼
Montreal L. H.& P., Canada	2,000,000	100	235½	236
Nashville Gas Light Co.	1,000,000	100	110	—
Newark, N. J., Con. Gas Co.	6,000,000	—	97	98
Bonds, 6's	6,000,000	—	127	128
New Haven Gas Co.	5,000,000	25	182	190
Peoples Gas Lt. & Coke Co., Chicago	25,000,000	100	110½	111½
1st Mortgage	20,100,000	1,000	102	102½
2d "	2,500,000	1,000	104	—
Rochester Gas & Electric Co.	2,150,000	50	88	—
Preferred	2,150,000	50	118	—
Consolidated 5's	2,000,000	—	104¾	105½
Pacific Gas and Electric Co.	15,500,000	—	58½	60
St. Joseph Gas Co.—				
1st Mtg. 5's	1,000,000	1,000	96	98
St. Paul Gas Light Co.	2,500,000	100	—	—
1st Mortgages, 6's	650,000	1,000	104	105
Extension, 6's	600,000	1,000	112¾	115
General Mortgage, 5's	3,447,000	1,000	94	96
Syracuse Gas Co., N. Y.	1,975,000	100	50	55
Bonds	2,047,000	1,000	101	103
Washington (D. C.) Gas Co.	1,600,000	200	427½	430
1st Mortgage, 6's	600,000	—	—	—
Western Gas Co., Milwaukee	4,000,000	—	—	—
Wilmington (Del.) Gas Co.	600,000	50	—	—

MEETING TIMES OF THE VARIOUS GAS ASSOCIATIONS.

American Gas Institute.—Annual meeting, Richmond, Va., October 15-17, 1913. Officers: President, W. R. Addicks, New York City. Secretary, Geo. G. Ramsdell, 29 West 39th st., N. Y. City.

Canadian Gas Association.—Annual meeting Sept. 1913. Officers: President, Arthur Hewitt, Toronto, Ont.; Secretary and Treasurer, John Keilior, Hamilton, Ont.

Empire State Gas and Electric Association.—Annual meeting, New York City, Oct. 8, 1913. Officers: President, C. G. M. Thomas, Long Island City, N. Y.; Secretary, C. H. B. Chapin, 29 W. 39th street. New York City.

Gas Meeters.—Monthly Section Meetings; Grand Commissioner, I. W. Peffly, New York; Gen'l Sec'y, H. Thurston Owens, La Crosse, Wis.; New York Section, Chairman, Will W. Barnes; Secretary, A. M. Berg, Sip ave., Jersey City, N. J. Philadelphia Section; Chairman, L. R. Dutton; Secretary, H. F. Patterson, Jr., 833 Chestnut street. Cleveland Section, Chairman, F. R. Hutchinson; Secretary, Wm. Holtz, East Ohio Gas Co. New England Section, Chairman, F. M. Roberts, Haverhill; Sec., F. K. Wells, 60 Broad street, Boston.

Gulld of Gas Managers of New England.—Annual meeting, March, 1913. Young's Hotel, Boston; monthly meeting, second Saturday. Officers: President, Walter G. Africa, Manchester, N. H.; Secretary, H. K. Morrison, Brockton, Mass.

Illinois Gas Association.—Annual meeting, March 19th and 20th, 1913. Chicago, Ills. Officers: President, H. O. Channon, Quincy, Ills.; Secretary-Treasurer, Horace H. Clark, 115 No. Oak Park avenue, Oak Park, Ills.

Illuminating Engineering Society.—Annual meeting,———— September, 1913. Meetings of Sections, monthly. Pres., Preston S. Millar; General Secretary, J. D. Israel, 29 W. 39th street, New York City. Sections: New York, Secretary, C. L. Law, 124 West 42d street. New England, Secretary, H. C. Jones, 10 High street, Boston, Mass. Philadelphia, Secretary, L. B. Eichengreen, Broad and Arch streets. Chicago, Secretary, J. B. Jackson, 28 North Market street. Pittsburgh, Secretary, J. C. Mundo, Oliver Building.

Indiana Gas Association.—Annual meeting, March 12 and 13, 1913. Indianapolis. Officers: President, Howard L. Olds, Indianapolis; Vice-President, Wm. Wallace, Lafayette; Secretary-Treasurer, Philmer Eves, Indianapolis.

Iowa District Gas Association.—Annual meeting, May 22, 23, 24, 1913; Burlington, Ia. Officers: President, C. W. Fair, Atlantic, Ia.; Secretary, G. I. Vincent, Des Moines, Ia.

Kansas Gas, Water and Electric Light Association.—Annual meeting, October—— 1913. ———— Officers: President, L. O. Ripley, Emporia, Kas.; Secretary and Treasurer, W. H. Fellows, Leavenworth, Kas.

Michigan Gas Association—Annual meeting, September——1913; ———— Officers: President, W. S. Blauvelt, Detroit, Mic; Secretary-Treasurer, Glenn R. Chamberlain, Grand Rapids, Mich.

Missouri Electric Light, Gas, Water Works and Street Railway Association.—Annual meeting, April, 1913; Mexico, Mo. Officers: President, P. A. Bertrand, Joplin, Mo.; Secretary and Treasurer, P. W. Markham, Brookfield, Mo.

National Commercial Gas Association.—Annual meeting and gas show, Dec. 1-6, 1913. Philadelphia, Pa. Officers: President, C. W. Hare, Philadelphia Pa.; Secretary, Louis Stotz, 29 West 39th street, New York City.

Natural Gas Association.—Annual meeting, Cleveland, O., May 20-22, 1913; Officers: President, M. B. Daly, Cleveland, O; Secretary, T. C. Jones, Delaware, O.

New England Gas Association.—Annual meeting, February, 18th and 19th, 1914 Boston. Officers: President, T. H. Hintze, Providence, R. I.; Secretary-Treasurer, N. W. Gifford, East Boston, Mass.

New Jersey State Gas Association.—Annual Meeting, April —, 1913, ———— N. J.—President, William H. Pettes, Newark, N. J.; Secretary-Treasurer, Arthur H. Osborn Belmar, N. J.

Ohio Gas Association.—Annual meeting, February ————, 1913, Columbus, O.; President, John M. Garard, Columbus, O.; Secretary, L. B. Denning, Columbus, O.

Oklahoma Gas, Electric and Railway Association.—Annual meeting, Oklahoma City May, ——1913. President, F. W. Caldwell, Shawnee, Okla.; Secretary, H. V. Bozell, Norman, Okla.

Pacific Coast Gas Association.—Annual meeting, San Jose, Cal., September 16, 17, 18, 1913. Officers: President, Henry E. Adams, Stockton, Cal.; Secretary-Treasurer, Henry Bostwick, 445 Sutter street, San Francisco, Cal.

Pennsylvania Gas Association.—Annual meeting, York, Pa., April 9-11, 1913; Officers, President, H. H. Ganser, Norristown, Pa.; Secretary-Treasurer, W. O. Lamson, Jr., West Chester, Pa.

Society of Gas Lighting.—Annual meeting Dec., 11, 1913; monthly meetings, second Thursday. Place, New York City. Officers: President, Fred. S. Benson; Secretary, George G. Ramsdell, 29 West 39th street, New York city

Southern Gas Association.—Annual meeting, Charlotte, N. C., April 18-20, 1913, Officers: President, C. E. White, Montgomery, Ala.; Secretary-Treasurer, R. D. Brewer, Atlanta, Ga.

Southwestern Electrical and Gas Association.—Annual meeting. May 21, 22, 23 and 24, 1913, Galveston, Tex. Officers: President, F. M. Lege, Jr., Galveston, Tex.; Secretary H. S. Cooper, 405 Slaughter Bldg., Dallas, Tex.

Wisconsin Gas Association.—Annual meeting, May 14 and 15, 1913, Milwaukee, Wis. Officers: President, I. F. Wortendyke, Janesville, Wis.; Secretary-Treasurer, Henry Harmon, Milwaukee, Wis.